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MANUAL

FOR

THE COLLEGE OF SURGEONS.

PRINTED BY C. ADLARD, BARTHOLOMEW CLOSE.

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MANUAL

FOR THE

COLLEGE OF SURGEONS

IN

LONDON, DUBLIN, AND EDINBURGH:

INTENDED FOR THE

USE OF CANDIDATES FOR EXAMINATION AND PRACTITIONERS.

BY
JOHN STEGGALL, M.D.
LICENTIATE OF THE ROYAL COLLEGE OF PHYSICIANS, LONDON, M.R.C.S. ETC.
AND
M. W. HILLES,
SENIOR LECTURER ON ANATOMY AND PHYSIOLOGY AT THE WESTMINSTER HOSPITAL SCHOOL OF MEDICINE.

LONDON:
JOHN CHURCHILL, PRINCES STREET, SOHO.
MACLACHLAN AND STEWART, AND CARFRAE AND SON, EDINBURGH
FANNIN AND CO., DUBLIN.
1839.

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PREFACE.

It has long appeared to the authors of the present work, that a compendium of the kind would be extremely useful to the younger members of the medical profession, not only in aiding them in their studies preparatory to examination, but as a concise work of reference on the most interesting and important parts of Anatomy and Surgery. A perusal of it will speedily show that it is not intended or expected to supersede the use of complete systems and extensive treatises, or that alone it should be sufficient for the student's purposes: it is designed to be, rather, like a collection of notes on the most striking subjects which he has made during his attendance on lectures and hospital practice.

The opinions given, and practice recommended, are such as are sanctioned by the most eminent men of our own and other countries; and in illustrating these, it has been the constant wish and endeavour to give the "why and because" on all occasions. In conclusion, the authors trust, that they have succeeded in meeting the expectations of their friends, and have produced a fund of information acceptable and useful to those for whom it is intended.

PART I.

ANATOMY.

MANUAL

FOR

THE COLLEGE OF SURGEONS.

ANATOMY.

THE BONES, LIGAMENTS, AND ARTICULATIONS, OR PASSIVE ORGANS OF LOCOMOTION.

The *bones*, *ligaments*, and *articulations* constitute the *natural skeleton;* the bones alone, the *artificial skeleton.*

The Bones are the framework of the body, to which the other structures are attached, or in which they are contained; and contribute largely to the formation of the articulations. They are divided into *long*, *flat*, and *irregular.*

The *long bones* are situated in the extremities, as in the thigh and leg, the arm and forearm, where great strength and considerable motion are required; they are expanded at each extremity for the formation of the joints,—are marked with eminences and depressions for the attachment of muscles and ligaments,—and are hollow in the interior for the medullary canal. Their structure is compact in the centre, spongy at the extremities.

The *flat bones* are placed so as to form cavities, as in the head and pelvis; they present two surfaces, an internal concave, and an external convex; they are thicker at the edges than in the centre; their *structure* consists of two compact laminæ enclosing an intermediate cellular structure, termed the diploë.

The *irregular bones* are situated where great strength and frequent motions are required, but the motion is of a compound nature, as in the *spine*, the *tarsus*, *carpus*, &c.; they are irregular in shape, and composed of spongy, covered by a thin layer of compact, tissue.

All bones cannot be comprised in these divisions, as, for example, the ribs: they resemble long bones in their length, and being expanded at their extremities, and flat bones, in forming the parietes of a cavity, and presenting a concave and convex surface; and are like irregular bones in their structure. Some divide the bones into *long*, *short*, *flat*, and *mixed.*

The number of bones in the human body is variable, owing to the irregular development of small bones in the tendons where these are exposed to friction, such as the sesamoid bones, and owing to the existence of ossa Wormiana or triquetra in the cranium; they also differ at the different periods of life; their number in the adult is estimated at 244.

The production and growth of bone have occupied the attention of many physiologists, and even now are not uniformly agreed upon.

Bone is supposed to be first prepared by the deposit of a gelatinous substance, which is penetrated by arteries, veins, and absorbents. This is gradually converted into cartilage, which presents a red appearance, from being permeated by numerous vessels carrying red blood. By degrees these vessels deposit osseous particles, which extend from a point in a radiating manner in the flat, and in a longitudinal direction in the long bones, the red colour disappearing with the increase of bony deposit; the spots from which the bony matter proceeds are called points of ossification. In the irregular bones, the points of ossification are numerous, corresponding with the several prominent portions of it: one, larger than another, is generally named the body. In the flat bones, the ossific points are likewise variable: thus in each parietal bone, there is only one; in the occipital, several. In the long bones there are three parts of distinct formation, the shaft and the extremities. The shaft is first deposited in the form of a ring of bone, whilst the extremities are still cartilaginous; in time the latter are incrusted with a bony deposit. Before osseous union with the shaft, they are named the *epiphyses;* after union, the expanded extremities or eminences are named *apophyses* or processes.

As a bone increases in thickness and hardness, its particles are not only elongated and new ones deposited, but fresh strata are formed varying in direction with the nature of the bone. In the cylindrical bones, they are deposited within the circumference, and thus tend to the diminution of the internal space. The fibres are also connected together by thin transverse plates, which give bone on minute inspection a cellular appearance, which, however, in some instances, is more of a distinct laminated character.

The circular deposits do not reach the centre of the long bones, but leave a cavity which contains the marrow, differing in quantity and quality at different ages, intersected however by some fibres which stretch across, and produce a latticed-work appearance. In the extremities these fibres are very numerous and give them quite a cellular structure, which is named *cancellous*, and which is also observed to be the structure of the bulk of the irregular bones.

The *cancelli* are lined with a delicate membrane, which has been named the *membrana medullaris.*

The marrow, like fat, is contained in distinct cells, which do not communicate. Minute arteries can be traced into them. The marrow differs with age: in the child, it is thin and sanguineous, in the adult more oily and consistent; and in old age, is again much thinner.

The bones are covered with a peculiar membrane, named *periosteum*, the surfaces of which correspond with the parts in relation with it. A similar membrane placed upon cartilages is called *perichondrium.* It is of use, in serving as a point of attachment of muscles, which also cause depressions and eminences in the bone, according to the mode and nature of their attachment. The periosteum is the direct medium, through which the bone (at least its outer part) is supported both with nourishment and vitality; from it the minute arteries proceed to enter the internal parts.

If a part of the shaft of a long bone dies, named the *sequestrum*, it is found to be incased by a new bony substance, supposed to be deposited by the periosteum. If the periosteum be removed and part of the surface of the bone be destroyed, the vessels of the internal parts have the power of throwing out gelatinous fluid which becomes cartilage and then bone, and may be entirely incased in the dead substance. Thus it appears that the vessels either of the periosteum, the bone itself, or medullary membrane, have each the power of secreting a nidus for bony deposits.

The mode of reunion of bone is the following: during the first week or more, blood is extravasated and appears to produce cohesion of the surrounding parts; in about ten days the redness disappears, the colouring matter of the blood is absorbed, and coagulated lymph remains; and at the same time the periosteum is found soft but thickened, and increased in vascularity, and the ends of the bones are inflamed, softened, and vascular, with their edges rounded off. This lymph becomes of a cartilaginous consistence, and is subsequently replaced by osseous matter on its surface. Similar changes take place internally in the fluid thrown out by the medullary membrane. In the succeeding stages, the ossific matter acquires increased thickness, becomes more firm, and is found gradually to unite the entire ends of the bones; and the surrounding cellular substance appears to form a new periosteum. In the last stage of restoration the superabundant ossific matter or *callus* is absorbed, the medullary canal is restored to its former state, and the irregularities on the bone are removed. Bones, like all other structures in the body, are always undergoing some renewal and absorption, which is shown by feeding an animal upon madder, and watching the changes produced in bone by it. In old persons the cavity in the cylindrical bones becomes gradually larger, and the walls proportionally more dense.

The formation of the flat bones of the cranium is somewhat different from that of the others. They are produced by a deposit of ossific matter between membranes, gradually extending from a central point to the circumference. The radiating fibres are connected together by transverse threads, which produce a spider-web appearance, and the intervals between the fibres are the passages for the vessels; when perfectly formed by successive layers of ossific matter, these bones exhibit an indurated external and internal table, with a cancellous structure between them named the *diploë.*

Many of the smaller bones of the face are formed in a similar manner to those of the cranium. The clavicle differs from the rest of the bones of the body in being quite bony from a very early period, not having visibly undergone the usual changes from gelatine into cartilage, and from this into bone.

The bones are supplied with distinct arteries, veins, and absorbents, and probably nerves; and according to the supply of blood from the arteries, and the character of the surrounding parts, so will be the tendency to reunion in case of fracture.

The LIGAMENTS are strong fibrous non-elastic structures connecting the bones, and principally situated about the articulations; their fibres run in different directions, leaving occasionally intervals between them for the passage of blood-vessels; they present a tolerably smooth and glistening appearance; are destitute of red vessels; nerves can be only inferred to exist in them from their being painful in disease; they are irregular in shape, size, and length, and are named from their *situation*, *shape*, *direction*, *attachments*, or *use*.

The ARTICULATIONS are composed of *bones*, *ligaments*, *cartilage*, and *synovial membrane*, where they enjoy any extent of motion, as in the hip and knee; but when immoveable, are composed merely of bones and ligaments. The *bones,* where they enter into the formation of the moveable articulations are expanded and covered over by a structure called *cartilage*. This forms a most important part in the mechanism of the joints: one surface of it is intimately adherent to the bone, which it covers, without having any intimate vascular connexion; the other surface is free, smooth, and polished, and is covered by synovial membrane. At first view it appears to be one homogeneous mass, but consists of fibres taking different courses, principally in an oblique direction towards the bone; its chief property is that of *elasticity*, by which it is enabled to prevent the effects of shocks, and to give free motion to the joints: neither vessels nor nerves can be traced into it, excepting at very early periods of life, when it has been stated to have been injected; their presence however, is inferred from the effects of disease. This cartilage is thickest in the centre, when it covers a *convexity*,—in the circumference, when it lines a *concavity*. All the parts comprising the moveable articulations are lined by *synovial membrane*. This is an exceedingly thin, delicate membrane, belonging to the class of *serous* membranes; it presents a smooth polished appearance, is transparent, destitute of red vessels and nerves, at least in a healthy state, forms a shut sac, secretes a glairy, transparent fluid, termed *synovia*, which lubricates the interior of the joint, and thus obviates the effects of friction; it cannot be demonstrated satisfactorily where it covers the cartilages, but is distinctly visible in other situations; it is frequently confounded with the capsular ligament.

CLASSIFICATION OF ARTICULATIONS.

The Articulations may be divided into COMPLETE *and* NON-COMPLETE.

COMPLETE, where the articulation is composed of bone, cartilage, ligaments, and synovial membrane, and admits of evident motion.	PLANIFORM.	Where the surfaces in contact are plane or nearly so, and possess the least motion.
	GINGLYMUS.	ANGULAR—*perfect* where the motions are confined to flexion and extension, as in the elbow. *Imperfect* where they also allow of slight lateral motion, as in the knee and ankle. LATERAL.—Where the surfaces are convex and concave, and allow of rotatory motion, as in the articulations between the radius and ulna, and the odontoid process of the dentata and atlas.
	EN-ARTHROSIS.	Where the bones present a ball and cup, or deep excavation, and where they enjoy every motion, that is, flexion, extension, adduction, abduction, rotation, and circumduction, as in the hip.
	ARTHROSIS.	Where the bones present a ball and socket, or superficial excavation, and either enjoy every motion, as in the shoulder, or where its motions are more confined, as in the temporo-maxillary articulation.

Non-complete, where the articulation is not composed of the before-mentioned structures, and where motion is either limited or entirely wanting.	Suture.	*Denticulated,* where the bones present a serrated appearance, and are interlocked with one another, as in the sagittal and coronal sutures. *Squamous,* where they overlap, as in the squamous suture of the temporal bone.
	Harmonia.	Where the bones present slightly rough substances, and are juxtaposed, as in the articulations of the superior maxillary bones.
	Gomphosis.	Where one bone is implanted into another, as a nail is into wood. The teeth in the alveoli are the only examples of this.
	Schindylesis.	Where one plate of bone is received into a groove or fissure in another, or between two other bones, as the vomer receives the azygos process of the sphenoid bone, or is received between the two superior maxillary bones.
		The above four possess no motion.
	Amphiarthrosis.	Symphysis. Where the bones are united by cartilage, or fibro-cartilage, little motion, if any, being enjoyed, as in the symphysis pubis, the sacro-iliac symphysis, the junction of the bodies of the vertebræ. Synchondrosis. Where the same connexion exists, but more motion is enjoyed, as between the ribs and costal cartilages.

The connexion between the *scapula* and *trunk*, and that of the *os-hyoides*, is called *sysarcosis,* but cannot be classed amongst articulations.

The motions enjoyed by articulations are, *flexion*, *extension*, *adduction*, *abduction*, *rotation*, and *circumduction.*

The Skeleton is divided into the *head*, *trunk*, *lower*, and *upper extremities.* The Trunk is divided into the *Spine*, *Thorax*, and *Pelvis.*

The Spine is a pyramidal column, situated at the *posterior* part of the trunk, extending from the head to the pelvis; it serves the important offices of supporting the head, thorax, and upper extremities superiorly, resting inferiorly on the pelvis, and transmitting their weight to the lower extremities; it also gives attachment to numerous muscles and ligaments, and affords lodgement to the spinal marrow and membranes, an important part of the nervous system; in its structure it combines the almost incompatible properties of *great strength*, *firmness*, *elasticity*, and *mobility*; into its formation we have *entering bones*, *ligaments*, *elastic structure*, *blood-vessels*, *nerves*, and *absorbents.*

BONES OF THE SPINE.

The bones of the spine are named vertebræ, and are called true, to distinguish them from the false vertebræ or bones which, separate in early life, afterwards unite to form the sacrum. They consist of seven cervical, twelve dorsal, and five lumbar, and belong to the class of irregular bones.

The vertebræ taken generally, consist of a *body* and *seven processes*, and present *four notches* and a *foramen*, with the exception of the atlas, which requires separate consideration.

The *body* forms the greatest portion of the dorsal or lumbar vertebræ; it has a rough articulating surface above and below; is anteriorly convex in the transverse direction; slightly concave perpendicularly, in consequence of the edges projecting to give attachments to ligaments. Posteriorly, the body is flattened, rather concave, and has numerous foramina in it for the entrance of the principal vessels.

The processes are seven, and are connected with the the posterior margin of the body by bony plates, named the *crura* or *pedicles,* above and beneath which is a notch completing the intervertebral foramina for the passage of the nerves, when the bones are articulated together.

The lateral processes are named transverse, and project horizontally; in the dorsal region marked by an articulating surface for the tubercles of the ribs; adjoining these are the four articular or oblique processes, two superior, and two inferior, which are for the articulation of the vertebræ together. Posteriorly, is the spinous process, projecting backwards in the mesial line, connected with the rest of the bone by quadrangular portions of bone, named *laminæ* or plates, which by their edges give attachment to the ligamenta subflava.

The notches, which by juxta-position of vertebræ form the intervertebral foramina, are anterior to the articulating processes in all the vertebræ, except the atlas and upper surface of the second cervical vertebræ.

The body and processes, united by the pedicles, form the bony walls of the vertebral or spinal canal.

The *cervical vertebræ* are distinguished by the following particulars:

The body is longest in the transverse direction.
    Its upper surface is broader than the lower, and is concave from side to side.
    Its lower surface is convex.
    It is deeper anteriorly than posteriorly.

The *transverse* processes arise by two roots, the anterior one from the body; they are bifurcated at their extremities, directed slightly forward, and near the base have a foramen for the passage of the vertebral artery.

The articulating processes superiorly look upwards and backwards; the lower ones downwards and forwards.

The *plates* are long and narrow.

The *spinous* processes are short, project almost horizontally backwards, and are bifurcated.

The spinal canal is large and triangular.

The particular cervical vertebræ, which require separate notice, are the *atlas*, the *axis* or *vertebra dentata*, and the seventh.

The *atlas* is distinguished by the following peculiarities:

It has no body, but is like a ring of bone.

It presents transverse and articulating processes, which divide it into an anterior and posterior half-arch.

The anterior half-arch, smaller, and convex anteriorly, presents a *tubercle*, with two lateral depressions for the attachments of the longi colli.

On its posterior surface it presents an articulating surface for the odontoid process of the second vertebræ; and further back, on each side, a tubercle, for the attachment of the transverse ligament.

Its superior and inferior edges give attachments to ligaments.

The transverse processes are on the same line as the articular, and project considerably outwards, and have the foramen for the vertebral artery.

The superior articulating processes are large and concave for the condyles of the occipital bone, directed upwards and inwards, and converging anteriorly.

The inferior articulating processes are circular and plane, and are directed downwards and inwards.

Behind these the intervertebral notches are seen, the upper one deep for the vertebral artery and suboccipital nerve; the lower one deep for the exit of the first cervical nerve.

The plates are rounded, and unite posteriorly without forming a spinous process.

The canal in the dry bone is very large, and in the recent state is divided into two by the transverse ligament.

The *second vertebra*, named also *dentata* or *axis*, is distinguished as follows:

The body is longer perpendicularly, in consequence of being surmounted by the odontoid process, which is articulated anteriorly with the atlas, and posteriorly with the transverse ligament. This process terminates in a summit, to which the moderator or check ligaments are attached.

On the anterior surface of the body of this vertebra, are two depressions, for the insertion of the longi colli.

The transverse processes are short and not bifurcated.

The superior articulating processes are circular.

The inferior articulating processes are oval, and directed downwards, forwards, and a little outwards.

The laminæ are short and strong.

The spinous process is short but broad, is bifurcated, and has a deep groove on its under surface.

The upper notch is behind the articular process, whilst the inferior notch is in front of it.

The *seventh* cervical vertebra is thus distinguished:

It is of a large size.

The spinous process is not bifurcated, but is long and projecting.

It has a foramen in the transverse process, smaller than in the rest.

Its general character approaches to that of the dorsal vertebræ.

The dorsal vertebræ are known by the following general characters:

The bodies are heart-shaped, with the antero-posterior axis longest, deeper posteriorly than anteriorly, to produce the concavity of the spine towards the thorax, and are marked, laterally near their crura, by half articular surfaces for the heads of the ribs.

The transverse processes are long, and directed upwards and backwards, and have, excepting the eleventh and twelfth, an articulating surface for the tubercles of the ribs.

The articulating processes are perpendicular, the upper looking directly backwards, the lower ones directly forwards.

The laminæ are broad, deep, and flat.

The spinous processes are long, triangular, and grooved inferiorly to rest close upon those below them: they incline more perpendicularly, proceeding downwards as far as the seventh or eighth, and then begin again to become more horizontal.

The spinal canal is circular, and rather smaller than in the cervical and lumbar regions.

The dorsal vertebræ, which are most distinguished from the rest, are the first, tenth, eleventh, and twelfth.

The first has the body longest transversely, and has an entire articulating surface on each side for the head of the first rib, and a half surface for the head of the second.

Its spinous process is very long, and projects almost horizontally backwards.

The tenth, eleventh, and twelfth vertebræ, have frequently a single articulating surface on each side of the body for the head of a rib; and no surface on the transverse process for the reception of the tubercle. The tenth sometimes partakes of the character of the vertebræ just above it.

The transverse processes are short.

The twelfth vertebra may be always distinguished by the inferior articulating processes, which have a direction corresponding with the lumbar, viz. forwards and outwards.

The general distinctive characters of the lumbar vertebræ are these:

The body has a great transverse extent.

Its vertical height is greatest anteriorly.

The transverse processes are long and slender, directed outwards, the third and fourth being the longest.

The superior articulating processes are concave, wide apart, looking backwards and inwards; the lower ones convex, directed forwards and outwards.

The laminæ are short and thick, somewhat overlapping each other.

The spinous process is horizontal, broad, and flat.

The spinal canal is triangular, as in the cervical region.

The last lumbar vertebra is thus distinguished:

The body is much deeper anteriorly than posteriorly, so as to rest upon the inclined plane of the sacrum.

The transverse processes are short and thick.

The inferior articulating processes are slightly convex, looking forwards and outwards.

The spinous process is short and rounded.

The structure of the bodies of the vertebræ is principally spongy, with a thin layer of compact osseous tissue, externally: they are hence very liable to caries, producing Pott's disease of the spine. The processes are composed chiefly of compact tissue.

They are developed from three ossific centres, one for the body and two for the processes, excepting the first vertebra, which has five, viz., one for the anterior half-arch, two for the posterior, and two for the lateral masses. The vertebra dentata has an additional point of the ossification for the odontoid process.

LIGAMENTS OF THE SPINE.

The vertebræ are connected together by powerful ligaments, and the inter-vertebral substance. The connexion between the two superior cervical vertebræ and the head, requires separate consideration.

Articulation of the occipital bone, with the atlas and axis. A broad ligament passes from the anterior edge of the foramen magnum, downwards and backwards in the spinal canal, over the moderator and transverse ligaments, is inserted into the posterior surface of the body of the vertebra dentata, and is continuous with the ligamentum commune posterius. It may be named occipito-axoidean ligament. When this is raised we see the transverse and moderator ligaments.

The *moderator*, *odontoid*, or *check* ligament of each side, arises from near the top of the odontoid process, passes outwards and a little upwards to be inserted into the edge of the foramen magnum, near the anterior extremity of the condyles of the occipital bone. They connect this bone with the head, and moderate the rotatory motion of the latter.

The *transverse* ligament passes from the eminence on the inner edge of the atlas, internal to the superior articulating process, on one side, to a corresponding part of the opposite side. From its centre it generally sends a prolongation upwards to the edge of the foramen magnum, and one downwards to the second vertebra, thus assuming a crucial appearance; it is always broadest in the centre, and in structure approaches to fibro-cartilage.

The atlas is connected with the occiput also by broad ligaments, anteriorly and posteriorly, which are named occipito-atlantoidean ligaments. They proceed from the upper edge of the atlas, and are inserted into the corresponding edges of the foramen magnum. The posterior ligament is perforated by the vertebral artery and sub-occipital nerve. Synovial capsules surround the articulation of the occiput with the atlas, and of the atlas with the axis. The odontoid process has one both upon its anterior and posterior surface. The articulation between the head and atlas is of the class *arthrosis*, that between the atlas and axis, *lateral ginglymus*.

Disease and accident in these articulations often cause sudden death, as in rupture of the check ligaments, in suspension of the body by the head, the escape of the odontoid process from the transverse ligament, or fracture of it, in executions, by which the spinal marrow becomes suddenly compressed.

The general ligaments of the spine are these:

Anterior common ligament.
Posterior ....
Ligamenta subflava.
Inter-tranverse.
...... spinous.
Supra-spinous.
Capsular.

The anterior common ligament proceeds from the second cervical vertebra, as far as the sacrum, stretching from vertebra to vertebra, attached to the edges of the vertebræ and inter-vertebral substance. It consists of three sets of fibres:

The *first* set, *superficial,* stretch between three or four vertebræ.
The *second* set, *middle,* pass from one vertebra to another.
The *third* set, *deep,* stretch from a vertebra to the intervertebral substance.

This ligament is broader as it descends, and is thickest in the dorsal region. It is perforated by a number of vessels.

The *posterior common ligament* is seen in the spinal canal, behind the bodies of the vertebræ. It appears to arise from the second cervical vertebra, and is lost at the upper part of the sacrum. In its course, it is firmly attached to the edges of the vertebræ and inter-vertebral substance, where it is expanded for preventing the substance, here almost fluid, from pressing upon the spinal chord: opposite the bodies of the vertebræ, the ligament is contracted, presenting on each side a lunated margin, and does not touch the bone, being separated by numerous vessels. In structure it is dense, firm, and glistening.

The *intervertebral substance*, fibro-cartilaginous, is found between all the vertebræ, and between the last lumbar vertebra and sacrum, but not between the atlas and axis. It is thin in the cervical region, thicker in the dorsal, thickest in the lumbar, very firmly attached to the various vertebræ. Its vertical thickness is greater anteriorly, in the cervical and lumbar portions, so as to produce the anterior convexity of those parts, but deeper posteriorly in the dorsal. It consists of decussating fibres, is dense in the circumference, but in the centre and near the vertebral canal is pulpy and semifluid, and is supposed to form a fluid pivot, around which the motions of the vertebræ are performed; this substance is very elastic, and preserves the spine from the effects of shocks. In the upright posture it is gradually compressed, hence a person is found to be perceptibly taller after long rest than after the fatigues of a day.

Small ligaments, named *crucial*, are described by some authors as crossing and covering this, anteriorly passing from one vertebra to another. They are not worth the name of separate ligaments.

The *ligamenta subflava* are situated posteriorly between the laminæ of the vertebræ, excepting between the first and second cervical: they are also found between the last lumbar vertebra and the sacrum. They extend from the inferior edge of the lamina of the vertebra above, to the edge of the one below; they do not quite meet in the mesial line; but leave a triangular interval, filled up with reddish cellular tissue. They have a yellow colour, are dense in structure, firm and elastic, resembling the yellow tissue of the middle coat of the arteries.

The other ligaments of the spine are less important, and are chiefly seen in the dorsal and lumbar region, muscles supplying their place in the neck.

The *inter-spinous* and *supra-spinous* ligaments are sufficiently explained by their names.

The *inter-transverse* ligaments are very indistinct, and are not described by some anatomists. Synovial capsules surround the articulations between the articulating processes of the vertebræ. These articulations are called *planiform.*

Viewing the spine generally on its anterior, posterior, and lateral aspects, the following particulars may be noticed, separating however the atlas from consideration.

Anteriorly, it presents on a cursory view a pyramidal form, but if examined more closely it appears to consist of three pyramids.

The first extending from the second to the seventh cervical vertebra.

The second is inverted and extends from the seventh cervical to the fourth or fifth dorsal.

The third extends from the fourth or fifth dorsal to the last lumbar vertebra or the sacrum.

In this aspect the spine is not quite straight, being generally a little inclined to the right side, in consequence of the more frequent use of the right arm.

Posteriorly, the spine presents the spinous processes, almost horizontal in the cervical and lumbar regions, and overlapping each other almost perpendicularly in the dorsal region: on each side of these, there is a deep grove, which decreases in breadth but increases in depth, from above downwards, to give lodgement to the various muscles.

The spine, viewed laterally, presents an undulating line, convex in the cervical and lumbar portions, concave in the dorsal; along it we see the intervertebral foramina, anterior to the transverse processes in the back and loins, but between them in the cervical region.

The motions of the spine are *flexion*, *extension*, *lateral motion*, slight *circumduction*, and *rotation*. The spine of the fœtus, presents a single inverted pyramid, and possesses but one curve, which is concave forwards: the spine of very old persons is curved like that of the fœtus, but the elastic structures have lost much of their elasticity, and are often converted into bone.

The muscles attached to the spine are symmetrical and consist of anterior and posterior. Those attached anteriorly are the following:

Rectus capitis anticus major.
.... *minor.*
.... *lateralis.*
Longus colli.
Scalenus anticus.
.... *medius.*
.... *posticus.*
Diaphragma.
Quadratus lumborum.
Psoas magnus.
...... *parvus.*
Obliquus internus;
Transversalis; } *through the medium of fascia.*

The muscles attached posteriorly are,

Trapezius.
Latissimus dorst.
Rhomboideus major.
.... *minor.*
Levator scapulæ.
Serratus posticus, superior.
.... *inferior.*
Splenius.
Complexus.
Sacro lumbalis.
Cervicalis descendens.
Trachelo-mastoideus.
Longissimus dorsi.
Transversalis colli.
Spinalis dorsi.
Semispinalis dorsi.
.... *colli.*
Rectus capitis posticus, major.
... . *minor.*
Obliquus capitis, superior.
.... *inferior.*
Multifidus Spinæ.
Interspinales.
Inter-transversales.
Levatores costarum.

THE THORAX.

The *Thorax* is a large conical cavity, for the lodgement of the *heart*, *lungs*, and *large blood-vessels*, and is composed of bones, cartilages, and ligaments: its walls are formed, *posteriorly*, by the dorso-thoracic vertebræ, and the ribs, as far outwards as their angles, *laterally*, by the bodies of the ribs, and, *anteriorly*, by the anterior extremities of the ribs, the sternum and costal cartilages.

THE BONES OF THE THORAX.

The *Bones* which enter into the formation of the thorax are the *dorsal vertebræ*, the *ribs*, and the *sternum*.

The *Ribs* consist of twenty-four irregularly-shaped bones, twelve on each side, extending from the vertebræ *posteriorly* to within a short distance of the sternum *anteriorly*, varying in length from above downwards, *increasing* from the first to the eighth, and then *decreasing;* they diminish in *breadth*, progressively from the first to the last, although not regularly so. They are divided into seven superior *true*, and five inferior *false ribs*, or, more properly, into *sternal* and *asternal*. The two lower ribs have no connexion with the rest by cartilage, but lie loose between the abdominal muscles, and are hence termed the *floating* ribs.

The ribs are expanded at their extremities, and are twisted at different parts in such a way as not to rest evenly on a horizontal plane.

They consist of a *head*, *neck*, *tubercle*, *body*, and an *anterior extremity*. The *Head* of the rib, situated at the vertebral extremity, presents a rounded eminence, divided by a horizontal ridge into two articular surfaces (of which the *superior* is the smaller), for articulation with two dorsal vertebræ, the ridge itself being received into the interval between them, and here firmly connected with the intervertebral substance.

The *Neck* of the rib extends from the head to the tubercle; it is round, of considerable length, and is directed downwards, backwards, and outwards: it gives attachment to the *inferior costo-transverse* ligament, and occupies, when in situ, the interval between the bodies, and the extremities of the transverse processes, of the vertebræ.

The *Tubercle*, is a rounded eminence, situated on the *posterior* surface of the rib, near its inferior edge: it is divided into an internal *articular*, and an external *non-*

articular portion; the *former* smooth and convex, articulates with the summit of the transverse process of the vertebra beneath; the *latter* is rough, for the attachment of the posterior *costo-transverse ligament.*

The *Body* of the rib commences at its tubercle and terminates at the anterior extremity. Its *outer surface* is convex, and is directed a little upwards; on it we perceive, as we pass outwards from the tubercle, a rough surface, of variable length in different ribs, *increasing* from the first to the ninth, and then *diminishing*, for the insertion of the longissimus dorsi muscle; then the *angle*, forming a remarkable protuberance posteriorly, and presenting a sharp ridge, directed obliquely downwards and outwards for the insertion of the sacro-lumbalis muscle; the angle is wanting in the first and twelfth ribs, and but badly marked in the second and eleventh: the *inner surface* of the rib is concave, directed downwards and inwards; the *upper edge* is rounded off, is directed a little inwards, gives insertion to the intercostal muscles; its *inferior* edge, turned outwards, is sharp and grooved internally for the intercostal artery, and gives origin to the intercostal muscles; its *anterior* extremity is hollowed out for the reception of the costal cartilage.

The *first*, *second*, *eleventh*, and *twelfth ribs*, present peculiarities which must be considered.

The *first rib* is much shorter than any of the rest; it is broad, thin, and flat, placed nearly horizontally, and is regularly curved, so as to form nearly a semi-circle, and to allow its extremities to rest, at the same time, on a horizontal plane; its *head* is not divided into two articular surfaces, but articulates with a whole surface on the body of the first vertebra; the neck is of considerable length; it wants the angle; its surfaces are directed upwards and downwards, the superior of which presents two depressions corresponding to the subclavian artery and vein, separated by a ridge into which is implanted the scalenus anticus muscle: its upper, or rather inner edge, does not give attachment to the intercostal muscles.

The *second rib* somewhat resembles the first; it is however, longer, and is intermediate in peculiarities between the first and the succeeding ribs.

The *eleventh* and *twelfth*, called also the *floating ribs*, are short and thin; the *head* presents a whole articulating surface for the body of the corresponding vertebra; they want the *tubercles* as they do not articulate with the *transverse processes;* the *angle* is badly marked in the eleventh, completely deficient in the twelfth; their anterior extremities thin, and pointed, are in general tipped with cartilage. The lower edge of the last rib gives attachment to some of the abdominal muscles, but not to the intercostals. The tenth rib occasionally resembles the eleventh and twelfth, in being articulated with but *one* vertebra, and not articulating with the transverse process.

The *Sternum* is a symmetrical bone situated in the *anterior* part of the thorax: its *upper* extremity is on a plane *posterior* to the *lower;* it is marked with four transverse lines, pointing out its original division into five pieces; in it we occasionally perceive a small *foramen*, the use of which is unknown: the *posterior* surface of the sternum is smooth and concave, and forms the anterior boundary of the anterior mediastinum; the *superior* extremity of the sternum is thick and excavated transversely, especially on its posterior edge for accommodating the trachea, and the interclavicular ligament, and presents *laterally* two cartilaginous surfaces, for the sternal extremity of the clavicle; the *inferior* extremity is the narrowest part of the sternum, and has attached to it a cartilaginous body exceedingly irregular in size, direction, and shape, termed the the *xiphoid* or *ensiform cartilage*, which gives attachment to the linea alba, and the costo-xiphoid ligament; it is occasionally bony in the old subject. The *lateral* edges of the sternum are thick, and possess seven concave articulating surfaces on each side, for the reception of the cartilages of the true ribs; they are separated by a considerable interval above, but inferiorly approach one another, so that the sixth and seventh are sometimes not more than a line asunder, the superior of these is circular, and has its cartilage continuous with that of the first rib.

The sternum in the adult is formed of two pieces, the *superior* of which is short, broad, and triangular, the base turned upwards, the apex downwards; it is marked *laterally* with the excavation for the first rib, and a half one for the second, and is connected to the *inferior* piece by a cartilaginous structure, allowing of a slight degree of motion, excepting in the old subject, in which it is most frequently ossified. The *inferior* piece is long and narrow, tapering towards each extremity, and presents on *each side* the corresponding half articular surface for the second rib, and five whole ones for the inferior five true ribs; the last of these is sometimes completed by the xiphoid cartilage. In the fœtus, the sternum consists of five pieces.

The *Costal Cartilages* complete the thorax *anteriorly;* they are twelve in number on each side; of these the seven superior only are directly connected with the sternum, the three succeeding are connected with the cartilage of the last true rib, and with one another, whilst the last two are suspended in the abdominal muscles; they *increase* in length from the first, which is short, to the seventh or eighth, and then *decrease* to the last, on which the cartilage is seldom more than half an inch in length; the two *extremities* are convex, the *external one* is received into a depression in the anterior extremity of the rib, to which it is immoveably connected; the *internal* is attached, in the true ribs, to the concave surfaces already described on the edges of the sternum, where a ball-and-socket joint is formed, lined by synovial membrane, and possessing considerable motion in the young subject; the cartilages of the three *superior false* ribs are continuous with one another and with the cartilage of the last true rib, and occasionally present on their edges (when they are in contact with each other) small articulating surfaces; those of the floating ribs are separated from the rest, and are lost in the abdominal muscles. The cartilage of the *first rib* is exceedingly *short*, and is remarkable for being more intimately connected with the sternum than the rest, and for being continuous with the *inter-articular cartilage* of the *sterno-clavicular articulation;* the *second* is remarkable for being identified at its anterior extremity with the cartilaginous structure already described as connecting the two pieces of the *sternum*, with each of which it is articulated. The *cartilages* of the ribs are frequently ossified, not only in the old subject, but even in the young, particularly in the phthisical individual; their structure then resembles that of the ribs.

LIGAMENTS AND ARTICULATIONS OF THE THORAX.

The *heads of the ribs*, presenting two convex articulating surfaces, are received into and between the articulating surfaces on the bodies of *two* of the *dorsal vertebræ*, and are connected to them by the *anterior costo-vertebral* or *stellated ligament*, the *inter-articular ligament*, and a *double synovial membrane.* The *tubercles* are *directly* connected to the *transverse process* of the inferior of the two vertebræ with which the head of each rib is articulated, by the *posterior* and the *middle costo-transverse ligaments*, and *a capsular ligament* lined by synovial membrane, and *indirectly* by the *inferior costo-transverse* ligament.

The *anterior costo-vertebral* or *stellated* ligament is situated in the *interior* of the thorax, it *arises* from the *anterior surface* of the *head of the rib*, from which it radiates to be attached to the *bodies* of the vertebræ above and below, and to the *intervertebral substance* in the centre.

The *inter-articular ligament* is situated in the interior of the joint and stretches from the ridge, already described in the head of the rib, to the *intervertebral substance*, with which it is continuous; it separates the synovial membrane of this articulation into two distinct sacs.

The *posterior costo-transverse ligament* arises from the extremity of the *transverse process* of the vertebra, passes almost transversely outwards to be inserted into the *non-articular portion* of the *tubercle* of the rib; it is a short and strong ligament.

The *inferior costo-transverse ligament* arises, narrow and pointed, from the inferior edge of the *transverse pro-*

cess of the vertebra *above; descends obliquely inwards, expands*, and is *inserted* into the upper edge of the neck of the rib *below*, near its connexion with the *body* of the vertebra: this ligament forms the external boundary of a triangular space through which the posterior branches of the intercostal artery and nerve pass: the triangle is completed *internally* by the body of the vertebra, and *superiorly* by the transverse process which forms its base.

The *middle costo-transverse* ligament is composed of a few irregular fibres connecting the *anterior* surface of the transverse process to the rib, and is seen by forcibly separating the bones.

The *capsular ligament* surrounds the articulation, and is lined by a synovial membrane: it is a complete ball-and-socket joint; it belongs to the class Arthrosis, and enjoys considerable motion, on which account it contains much synovial fluid. The first rib wants the *interarticular* and the *inferior costo-transverse ligaments.* The eleventh and twelfth ribs want the *interarticular ligament.* The twelfth is unprovided with the *inferior costo-transverse ligament*, but has attached to its inferior edge the *false ligamentum arcuatum*, to be described with the diaphragm. The *anterior extremities* of the ribs are connected to the costal cartilages by means of a *synchondrosis* articulation, and by the tendinous expansions derived from the different muscles in the neighbourhood, which also serve to connect the *cartilages of the ribs* with the *sternum;* these, in addition, possess a synovial membrane, and enjoy a good deal of motion: they form an arthrodial articulation. The last true rib is connected to the xiphoid cartilage by the costo-xiphoid ligament. The *structure of the ribs* is *compact* externally, *spongy* internally; that of the *sternum* principally *spongy*, with a thin layer of compact tissue externally. The *structure* of the cartilages resembles that of cartilage in other situations; they possess great elasticity, and are frequently ossified in the old subject.

The ribs have three points of ossification, one for the head, a second for the tubercle, and the third for the body.

The Muscles attached to the Ribs on each side are:

Pectoralis major.
.... *minor.*
Subclavius.
Scaleni.
Latissimus dorsi.
Serratus magnus.
Serratus superior posticus.
.... *inferior* ....
Sacro-lumbalis.
Longissimus dorsi.
Levatores costarum.
Intercostales.
Sterno-costalis.
Diaphragma.
Obliquus externus abdominis.
.... *internus* ....
Transversalis } *abdominis.*
Rectus }
Quadratus lumborum.

Muscles attached to the Sternum:

Sterno-mastoid.
...... *hyoid.*
...... *thyroid.*
Pectoralis major.
Sterno-costalis.
Intercostales interni.

Muscles attached to the Ensiform Cartilage by an aponeurosis:

Rectus abdominis.
Obliquus externus.
.... *internus.*
Transversalis.
Diaphragma.
Sterno-costalis.

THE PELVIS.

The pelvis is a large bony cavity, situated at the *inferior* part of the trunk, supporting the spine, resting on the lower extremities, and containing the pelvic viscera; it is formed by four bones, the *sacrum*, two *ossa innominata*, and the *os coccygis*.

The *sacrum* is situated at the *posterior* part of the pelvis, of a triangular or wedge shape, with the base directed upwards and the apex downwards; it is firmly impacted between the ossa innominata, and presents a *base*, an *apex*, an *anterior* and a *posterior* surface, and two *lateral edges*.

The *base* of the sacrum is turned *upwards* and slightly *forwards*, and presents its greatest extent in the transverse direction; it projects *anteriorly*, where it forms the *promontory* of the *sacrum; behind* this is the upper aperture of the *sacral canal* of a triangular shape, giving lodgement to the termination of the cauda equina. The *anterior surface* of the sacrum looks also *downwards*, and presents in the centre four or five *transverse ridges*, indicating the division of the different pieces (termed *false vertebræ*), of which the sacrum is composed in infancy; on *each side* of these are the *anterior sacral foramina*, for transmitting the anterior sacral nerves, four or five in number, much larger than the posterior, and diminishing in size from above downwards; they are separated by bony surfaces, which give attachment to the pyriformis muscle: the *posterior surface* of the sacrum is turned considerably upwards, and is convex and irregular; we observe on it, in the mesial line, four or five eminences, more or less united, which correspond with the spinous processes of the vertebræ; at their *inferior extremity* is a triangular aperture in which the spinal canal terminates, bounded laterally by two tubercles, which give attachment to the sacro-sciatic ligaments; beneath them is a groove which forms, with the os coccygis, a foramen for the transmission of the last sacral nerve; on *each side* of the spinal eminences is a groove continuous with the vertebral gutters above, and perforated by the four or five *posterior sacral foramina,* for transmitting the *posterior sacral nerves*, much smaller than the anterior, and diminishing in size from *above downwards—externally* to these are rough lines, analogous to transverse processes, for the attachment of ligaments; the *lateral edges* of the sacrum are wide above, narrow and thin inferiorly; they are marked *superiorly* by a rough articular surface, resembling somewhat the *human ear* with the concavity turned backwards, for connexion with the os innominatum: *beneath* this it gives attachment to the *sacro-sciatic ligaments*, and forms part of the *great sciatic notch.* The *sacrum* belongs to the class of irregular bones, and is composed almost altogether of *spongy* structure.

The *os coccygis* is an assemblage of three, four, or five small irregular bones, decreasing in size from *above downwards*, and held together by ligaments; they are consolidated, not only together, but with the sacrum, in the male subject at the age of thirty-five or forty, but in the female not till forty-five or fifty. They are chiefly composed of spongy tissue.

The *ossa innominata* are two irregularly-shaped bones situated one on each side of the pelvis; each consists of three parts, the ilium, ischium, and pubis, firmly united in the adult, but separated in the young subject: these three bones unite together in the *acetabulum,* the ischium forming rather more than two fifths, the ilium rather less than two fifths, and the pubis one fifth. Of the three parts, the ilium is the largest, and forms the superior expanded part of the os innominatum; the ischium is next in size, and forms the posterior inferior part; whilst the pubis is the smallest, and occupies the anterior part of the bone. On the outer surface of the os innominatum the parts seen are, posteriorly, a rough surface, for the attachment of the glutæus maximus; anterior to this a smooth surface, bounded by a slight crescentic ridge, which commences at the anterior superior spinous process, for the attachment of the glutæus medius; and beneath this a semicircular surface, for the glutæus minimus, on which is often seen a foramen for a nutritious artery; still lower, and somewhat anterior to the last, is a rough surface, for the attachment of the origin of the rectus and cotyloid ligament, and just below it the acetabulum. In the part of the os innominatum, below the acetabulum, we notice the several parts of the os pubis and ischium, and between them the obturator foramen (the largest bony foramen in the body), giving attachment to the obturator ligament; above and internally is the angle of the pubis, passing downwards to the descending ramus of the pubis, and this lower down continuous within the ramus of the ischium: beneath this is the *tuberosity* of the ischium, a large bony prominence projecting inferiorly, and affording origin to several muscles: upon this we rest in a sitting posture: *ascending* from this towards the acetabulum, we meet with a deep groove, which gives lodgement to the *obturator externus* tendon.

The *internal surface* of the os innominatum is divided into a *superior* and *inferior* part by a prominent ridge, termed the *linea ileo-pectinea;* the *superior*, called also the *iliac fossa,* is filled up by the *iliacus* internus muscle; in it we perceive a large nutritious foramen. The *linea ileo-pectinea* commences *anteriorly* sharp and prominent at the spine or tubercle of the pubis, from this, passes backwards and outwards, and then turns slightly inwards, and terminates at the junction of the sacrum and ilium, where it is rounded off; at its *anterior* extremity it gives attachment to Gimbernat's ligament, which occupies nearly an inch, then to the pectineus muscle and pectineal portion of the fascia lata for about an inch and a half, and then to its termination *posteriorly*, to the iliac fascia.

The *circumference* of the os innominatum presents an exceedingly undulating line; if we trace it along, commencing *anteriorly* at the anterior superior spinous process of the ilium, we meet with the following objects: first, the *anterior superior spinous process* of the ilium, which gives origin to the sartorius muscle, and Poupart's ligament *anteriorly*, and the tensor vaginæ femoris *externally;* beneath this is a *notch* for the exit of the inguino-cutaneous nerve, bounded *inferiorly* by the *anterior inferior spinous process* of the ilium, from which arise the rectus femoris muscle and the accessory ligament of the hip-joint, then a deep groove through which glide the tendons of the psoas magnus and the iliacus internus muscles; internal to this the *ilio-pectineal* or *pubal* eminence, into which is inserted the psoas parvus tendon, and which marks the junction of the ilium and pubis; internal to this is a long triangular portion of bone, its apex internally, its base externally, slightly excavated, termed the *horizontal ramus* of the pubis, from which the pectineus muscle arises, then the spine or *tubercle* of the pubis, a projecting pointed eminence which serves for the insertion of the outer pillar of the external abdominal ring; next the *crest* of the pubis, extending horizontally between this and the symphysis pubis, and affording origin to the rectus and pyramidalis muscles, and forming the base of the external abdominal ring; descending from this is the *angle* of the pubis, formed between the *crest* and *symphysis* pubis, in front of which passes the internal pillar of the ring; descending vertically is the *symphysis pubis*, where the two ossa innominata are joined by cartilage, then the edge of the descending ramus of the pubis and ascending of the ischium affording attachment to the triangular ligament, the perineal fascia, the crura penis, erector penis muscle, &c.; then the *tuberosity* of the ischium, giving attachment to the biceps, semitendinosus and semimembranosus muscles inferiorly, the quadratus femoris and inferior gemellus posteriorly, together with the great sacro-sciatic ligament; superior and posterior to this is the *lesser sciatic notch*, a smooth depression, prolonged internally, between the tuberosity and spine of the ischium, through which passes *out* the tendon of the obturator internus muscle, by which it is sometimes grooved; above this is the *spine* of the ischium, a sharp bony prominence for the insertion of the lesser sacro-sciatic ligament and the origins of the superior gemellus muscle *externally*, the coccygeus muscle *internally*;

next is the great *ischiatic* or *sciatic notch* completed posteriorly by the edge of the sacrum, and converted into a foramen by the great sacro-sciatic ligament; this is bounded posteriorly by the *posterior inferior spinous process* of the ilium, but badly marked, articulated with the sacrum, to which it is connected by ligaments, and *internally* marked by a rough articulating surface, which corresponds with that on the sacrum; above this, is the *posterior superior spinous process* of the ilium, giving attachment to the sacro-iliac and ilio-lumbar ligaments; and lastly is the *crest* of the ilium, which gives attachment by its *outer* edge to the external oblique, latissimus dorsi, and glutæus maximus muscles, by its *internal*, to the transversalis and quadratus lumborum, and between these edges, to the internal oblique muscle; it terminates *anteriorly* at the anterior superior spinous process of the ilium. The ossa innominata belong to the class of flat bones, their *structure* is therefore *spongy*, enclosed between two laminæ of compact tissue.

THE LIGAMENTS OF THE PELVIS.

The bones of the pelvis are connected to one another, and with the last lumbar vertebra, by powerful ligamentous and cartilaginous structures. The *sacrum* is connected to the last *lumbar vertebra* by the *intervertebral substance*, the *ligamenta subflava*, and the continuation of the *anterior* and posterior common ligaments, &c., precisely as the vertebræ are connected together, with the addition of the following ligament.

The *sacro-vertebral* ligament arises on each side from the anterior and inferior surface of the transverse process of the last lumbar vertebra, descends obliquely downwards and outwards, and is inserted into the base of the sacrum, where it is continuous with the other ligamentary structures in this situation.

The *ilium* is connected to the *spinal column* by the *ilio-lumbar* ligament only; it is of a triangular shape, and arises narrow, thick, and pointed from the summit of the transverse process of the last lumbar vertebra; it passes almost horizontally outwards, and is implanted into the posterior superior spinous process of the ilium: it gives origin by its upper edge to the quadratus lumborum muscle.

Between the *sacrum* and *ilium* we have an articulation, more frequently called the sacro-iliac symphysis, from its possessing little if any motion; this articulation is formed by irregular articulating surfaces on the lateral surfaces of the sacrum and ilium, each of which is lined by a thin layer of cartilaginous structure almost united together in the adult, and possessing in its interior a remarkable semifluid substance: in the fœtus the articulation is lined by a synovial membrane; *anteriorly* and *posteriorly* it is strengthened by irregular bands of fibres, termed, from their situation and attachment, the *anterior* and *posterior sacro-iliac* ligaments; they are exceedingly strong, and are attached *internally* to the sacrum, and *externally* to the posterior inferior spinous process of the ilium, spreading out to be continuous with the periosteum and the other ligaments of this part.

The *sacrum* is connected to the *ischium* by the *greater* and *lesser sacro-sciatic ligaments.*

The *greater sacro-sciatic* ligament arises from the lateral and posterior surfaces of the sacrum, and also from the posterior inferior spinous process of the ilium and edge of the os coccygis; it passes *downwards*, *forwards*, and *outwards*, and is implanted into the tuberosity of the ischium, whence it sends a prolongation forwards to be continuous *externally* with the origins of the hamstring muscles, *internally* with the obturator fascia, and is prolonged *anteriorly* into a process which assists in binding down the internal pudic artery; this ligament is somewhat of an hour-glass shape, narrow and thick in its centre, broad and thin at its extremities; its *outer* surface gives origin to the glutæus maximus muscle: it forms the *posterior lateral* boundary of the perinæum, and is situated external and posterior to the lesser sacro-sciatic ligament.

The *lesser sacro-sciatic ligament* arises, *internal* and *anterior* to the greater, from the edge and anterior surface of the sacrum and edge of the os coccygis, where it is broad and expanded; runs horizontally *forwards* and *outwards*, and terminates in a point, which is implanted into the spinous process of the ischium. The *great sacro-sciatic ligament* converts the sciatic *notch* into a large *foramen*, which is divided into a greater and lesser by the *lesser sacro-sciatic ligament;* the smaller of these gives egress to the tendon of the obturator internus muscle, ingress to the pudic vessels and nerves; the greater foramen gives exit to the pyriformis muscle, the gluteal artery, and superior gluteal nerve, the greater and lesser sciatic nerves, the sciatic and pudic arteries: the first two pass out above the muscle, the remainder below it. These ligaments, besides connecting the bones together, serve the important office of closing up the inferior aperture of the pelvis, and thus assist in supporting the weight of the pelvic viscera.

The ossa pubis are united by a fibro-cartilaginous structure, termed the symphysis pubis; this more properly consists of two portions, one of which belongs to each os pubis; they are of an oval shape, thin *posteriorly*, thick *anteriorly*; they are dense and elastic, and are composed of fibres, taking different directions, some transverse, others concentric; in some subjects, particularly in the female, a *synovial membrane* has been described as existing between these cartilages near their *posterior* surface: it is said to be lubricated with a little fluid, and to allow of slight motion. This articulation is strengthened in front and behind by fibrous structures, termed its anterior and posterior ligaments; they are not important.

The ossa innominata are further connected by the *sub-pubic ligament*, the *triangular ligament* of the urethra; which parts will be more properly described, when considering the genito-urinary organs. The *obturator* foramen is nearly closed up by the *obturator ligament*; it is an exceedingly thin, delicate ligament, deficient *superiorly*, to allow of the passage of the obturator vessels and nerves: it is covered *internally* and *externally* by the obturator internus and externus muscles, respectively.

The pelvis, thus formed, is divided into the *false* and *true* by the *linea ilio-pectinea*: the expanded portion *above* that line is the *false* pelvis, the deep contracted portion below this line is the *true* pelvis. The *superior* aperture of the *true* pelvis is much smaller than that of the *false*; it is *triangular* in the male, its base posteriorly, *oval* in the female, with its long axis directed transversely; it is directed downwards and backwards, and a line prolonged downwards through its centre will touch the lower third of the sacrum. The *inferior* aperture of the pelvis is of a diamond shape, long from before backwards, expanded in its centre between the tuberosities of the ischia: pointed posteriorly at the extremity of the os coccygis, and anteriorly at the sub-pubic angle: formed by the meeting of the os pubis of each side; it is bounded *posteriorly* by the os coccygis; *laterally* by the sacro-sciatic ligaments, the tuberosities of the ischia in the centre, and the rami of the ischium and pubis in front; and *anteriorly* by the sub-pubic ligament filling up the angle of the pubis; its axis is downwards and a little backwards: a line drawn upwards through its centre will touch the sacro-vertebral angle.

In the fœtus the pelvis is remarkably small, and consists of several bones, the sacrum being then divided into four or five pieces, and the os innominatum into the ischium, ilium and pubis, all of which become consolidated before the age of puberty; they are nearly straight, so that the cavity of the pelvis scarcely exists, and present epiphyses at the crest of the ilium and the tuberosity of the ischium; the bladder, rectum, and small intestines then chiefly occupy the abdominal cavity: its aperture is more directly forwards; the change which takes place in the adult being produced by the gradual development of the anterior part of the pelvis, and from its being forced upwards in front by the ossa femoris and pressed downwards by the spinal column behind. In old persons the pelvis undergoes but little alteration, if we except the change in the ossific deposit which occurs in all bones; its obliquity is lessened by the spine curving forwards, and the knee bending so as to preserve the centre of gravity.

Muscles attached to the Sacrum :

Pyriformis.
Coccygeus.
Latissimus dorsi.
Longissimus dorsi.
Multifidus spinæ.
Glutæus maximus.

Muscles attached to the Coccyx :

Glutæus maximus.
Coccygeus.
Sphincter ani.
Levator ani.

Muscles attached to the several parts of the Os Innominatum :

Ilium—to the outer surface	*Glutæus maximus.* .... *medius.* .... *minimus.*
to the internal surface	*Iliacus.*
to the crista	*Obliquus externus abdominis.* .... *internus* .... *Transversalis.* *Latissimus dorsi.* *Sacro-lumbalis.* *Longissimus dorsi.* *Quadratus lumborum.*
to the anterior superior spinous process	*Tensor vaginæ femoris.* *Sartorius.*
to the anterior inferior spinous process	*Rectus femoris*, and its external tendon from the brim of the acetabulum.
Os Pubis—to the crista	*Pyramidalis.* *Rectus abdominis.*
to tubercle and anterior surface	*Obliquus externus.*
to pectineal line	*Pectineus.*
to crista and symphysis	*Obliquus internus.* *Transversalis.*
to external angular surface	*Adductor longus.* .... *brevis.*
.... ramus	*Gracilis.*
.... margin of obturator foramen	*Obturator externus.*
to inner surface	*Obturator internus.* *Levator ani.*

Ischium—ramus and outer border of tuberosity	*Adductor magnus.*
inner edge of tuberosity	*Erector penis.*
.... ramus	*Transversus perinæi.*
inner surface	*Obturator internus.*
posterior suface of tuberosity	*Biceps.* *Semitendinosus.* *Semimembranosus.*
rough line on outside	*Quadratus femoris.*
surface contiguous to spine	*Gemellus inferior.*
spine	*Gemellus superior.* *Coccygeus.*
internal surface	*Levator ani.*

THE BONES OF THE LOWER EXTREMITIES.

The BONES of the *lower extremity* consists of the *femur* or *thigh bone*, the *patella*, the *tibia*, and the *fibula*, which are those of the *leg;* together with those of the foot, consisting of the *astragalus*, *os calcis*, *os naviculare*, or *scaphoides*, *os cuboides*, *three ossa cuneiformia*, *five metatarsal bones;* and *fourteen phalanges*, constituting the *toes*.

The *femur* or *thigh bone* is the longest and largest bone in the body; it consists, from above downwards, of a *head*, *neck*, *trochanters*, *body* or *shaft* of the bone, and the *condyles*.

The *head* of the femur is encrusted with cartilage; near the centre of it is a depression for the attachment of the ligamentum teres.

The *neck* descends obliquely downwards and outwards, somewhat triangular in form, having its apex at the head of the bone, the base towards the shaft, where it is limited by the inter-trochanteric lines; it is longer posteriorly, and is porous for the transmission of vessels.

We next notice the trochanters, major and minor.

The *trochanter major* projects beyond the shaft of the bone, and in the recent state is covered by a bursa; its inner surface, concave, is marked by a deep depression, termed the *digital fossa*, into which several muscles are inserted.

The *trochanter minor*, smaller and somewhat triangular, is situated lower and somewhat at the posterior part of the femur. From it three lines proceed; two upwards, named inter-trochanteric, and one downwards, which terminates in the linea aspera.

The *body* or *shaft* of the bone is directed obliquely downwards and inwards, somewhat quadrilateral at the upper and lower parts, but triangular in the centre. It presents an anterior, posterior, internal and external surface. The anterior surface gives attachment by its upper three fourths to the cruræus, in the lower part to the subcruræi. The external surface, largest, gives attachment to the vastus externus; the internal surface is covered by the vastus internus; a portion of this surface, about an inch in breadth extending nearly the whole length, has no muscular attachment. The posterior surface is narrow in the centre, but expanded above and below; on it we see the *linea aspera* sometimes divided by a groove into two; it arises by two lines: the external one most prominent proceeds from the trochanter major, and gives attachment to the vastus externus and adductor magnus, and to the tendon of the glutæus maximus; the inner line arises from the trochanter minor, and gives attachment to the pectinæus, vastus internus, and adductor brevis.

By the convergence of these lines the linea aspera is formed, which terminates inferiorly in two ridges, which pass down to the condyles; the external one is strongest, and best marked.

The condyles are two: one external, and one internal.

They enter into the composition of the knee-joint. In front a depression separates them, named the *anterior inter-condyloid fossa*, which gives lodgement to the patella; there is a deep depression between them posteriorly, named posterior inter-condyloid fossa, which lodges the popliteal artery, but is nearly filled up by the ligament of Winslow. On the outer surface of the outer condyle is a well-marked eminence for the attachment of the external lateral ligament, and below it a depression for the tendon of the poplitæus.

On the inner surface of the inner condyle is a large prominence, giving attachment to the tendon of the adductor magnus and internal lateral ligament.

The two condyles differ from each other in many particulars.

The internal condyle is

longer from before, backwards;
shorter transversely,
projects more posteriorly,
.... less anteriorly,
descends lower when the bone is placed vertically.

Both of them are covered with cartilage to a much greater extent posteriorly than anteriorly.

The femur is articulated with three bones, viz. the os innominatum, tibia, and patella. It consists of compact tissue in its centre, spongy at its extremities. Numerous small arteries supply it, especially near the extremities, and a nutritious branch is found to enter the shaft along the linea aspera, either midway or a little higher up. It has five points of ossification; one for the head, one for each trochanter, one for the shaft, and one for the condyles.

Muscles attached to the Femur:

To Trochanter major	*Glutæus medius.* .... *minimus.*
Trochanter minor	*Psoas magnus.* *Iliacus.*
Trochanteric fossa	*Obturator externus et internus.* *Gemellus superior et inferior.* *Pyriformis.*
Posterior inter-trochanteric line	*Quadratus femoris.*
rough surface below trochanter major	*Glutæus maximus.*
line leading from trochanter minor	*Pectinæus.*
linea aspera	*Vastus externus et internus.* *Triceps adductor.* *Biceps* (its short portion).
external condyle	*Gastrocnemius.* *Plantaris.* *Poplitæus.*
internal condyle	*Gastrocnemius.*
Anterior surface of shaft	*Cruræus.* *Subcruræus.*

THE BONES OF THE LEG.

The bones of the leg consist of the *patella*, the *tibia*, and *fibula*.

The *Patella* is situated at the anterior part of the knee-joint, between the femur above and the tibia below, of a triangular or heart-shape, having its base *above*, its apex *below;* the *base* of the patella is thick, cut off obliquely upwards and backwards, and gives insertion to the tendon of the rectus femoris, and cruræus muscles; its *apex* narrow and pointed, directed downwards, gives attachment to the ligamentum patellæ, the *anterior surface* is convex and rough, and is marked by longitudinal lines produced by the fibres of the rectus tendon, in which this bone is developed, and by small foramina for the transmission of vessels; it is covered by a large bursa mucosa, and by a tendinous aponeurosis, derived from the extensor tendons; the *posterior surface* is smooth and incrusted with cartilage, as it enters into the formation of the knee-joint; it is divided by a ridge running nearly vertically with a slight degree of obliquity inwards into two unequal portions, an *external* and *internal*: the *external* is large, corresponds to the articulating surface on the anterior part of the external condyle of the femur, the *internal* smaller, and is in contact with the internal condyle: the *lateral* edges are thin, convex, and irregular, and give insertion to the vasti muscles.

Its *structure* is spongy, covered with a thin layer of compact tissue; it is developed by a single point of ossification which is deposited in the substance of the rectus tendon, from which it derives the appearance of longitudinal fibres remarkable on its anterior surface; it is not completely ossified until many years after birth, and may be considered more properly as a *sesamoid* bone; it articulates only with the femur, being connected to the tibia by ligament; in the *extended* position of the knee-joint it rests on the anterior surface of the condyles of the femur, but in the *flexed* position corresponds to the interval between the two bones.

The muscles attached to it are

Rectus femoris.
Cruræus.
Vastus externus.
.... internus.

The *Tibia* is the principal bone of the leg, and is divided into a *superior* or *femoral extremity*, a *body* or *shaft*, and an *inferior* or *tarsal extremity*. The *upper* or *femoral extremity* is much larger and more expanded than the *lower*; it is somewhat *oval*, longest *transversely*; on its upper surface we observe two articulating surfaces, an *external* and an *internal*, termed the *condyles* of the tibia, incrusted with cartilage for articulation with the femur, and separated from one another by a large bony prominence, termed the *spine*, and two rough surfaces, one in front, the other behind the spine; the *internal articular surface* is of an oval shape, long from before backwards, is concave and more excavated than the external, corresponding with the internal condyle of the femur; the *external articular surface* is nearly circular, and but *slightly* excavated.

The *spine*, somewhat pyramidal in shape, is directed a little inwards and is placed nearer the *posterior* than the *anterior* part of the tibia; in front of, and behind the spine, are two rough surfaces: the *anterior* one, large and irregular, gives insertion to the anterior extremities of the semilunar cartilages and to the anterior crucial ligament; the *posterior*, small and excavated posteriorly, affords insertion to the posterior extremities of the semilunar cartilages and the posterior crucial ligament; as we descend from the articulating surfaces of the tibia we meet with, *anteriorly*, a large eminence, termed the *tubercle* of the tibia, which gives insertion to the *ligamentum patellæ*; on the *outer side* of the tibia is a projection of the bone marked inferiorly by an articular surface, smooth for articulating with the upper extremity of the fibula; *internally* is a projection for the insertion of the internal lateral ligament of the knee-joint, marked with a groove for the anterior insertion of the semimembranosus muscle, *posteriorly*, a superficial depression filled up by the posterior crucial ligament; the *body* or *shaft* of the tibia is that part intervening between the upper and lower extremities: it is large and triangular *above*, but becomes smaller and more circular *inferiorly* until we approach the inferior extremity where it again expands; it may be divided into *three surfaces*, an *internal*, *external*, and a *posterior*, separated by *three ridges*, an *anterior*, *external*, and *internal;* of these, the anterior one is commonly named the *shin.* The *inferior* or *tarsal* extremity of the tibia expands, and assumes a quadrilateral shape; *anteriorly* it presents a convex extensive surface, into which the anterior ligament of the ankle-joint and anterior tibio-fibular ligament are attached, and over which glide the tendons of the anterior muscles of the leg; *posteriorly*, a rough surface which gives attachment to the posterior ligament of the ankle-joint, and the posterior tibio-fibular ligament, and is marked towards its inner edge by a superficial groove running downwards and inwards, which gives lodgement to the tendon of the flexor longus pollicis muscle; *externally*, is a rough triangular surface, concave, which gives lodgement to the fibula, and attachment to ligaments which connect these bones together; *internally*, the tibia descends farther than in any other direction, and presents a thick and slightly convex quadrilateral projection, termed the *internal malleolus.*

This eminence is situated on a plane anterior to the body or shaft of the bone; *internally*, it is rough, convex, and covered only by the integuments; *externally*, it is marked by an articulating surface of a pyriform shape, to correspond with a similar surface on the astragalus, for the formation of the ankle-joint; it is continuous with the articulating surface of the lower part of the tibia, which it joins at a right angle; *posteriorly*, it is grooved for the transmission of the tibialis posticus and flexor communis tendons; *inferiorly*, it tapers a little, descends lower in front than behind, and gives attachment to the internal lateral ligament of the ankle-joint.

Inferiorly, the lower extremity of the tibia presents a surface covered by cartilage for articulation with the upper surface of the astragalus; it is somewhat quadrilateral, concave from before backwards, convex transversely, owing to a ridge which traverses it in the antero-posterior direction, it is wider anteriorly than posteriorly, and broader *externally* than *internally*; it is bounded *externally* by the articulating surface for the fibula; *internally* by the internal malleolus, anteriorly and posteriorly by the projecting edges of the tibia.

The tibia articulates with three bones; the femur, the fibula, and the astragalus; its structure is like that of the femur, except that its extremities are rather more spongy; its medullary canal is well marked; it is supplied with blood-vessels from the neighbouring trunks, which enter as in the femur. This bone is developed by three points of ossification, one for the body, and one for each extremity; the tubercle is occasionally distinct from the rest of the bone, but soon becomes consolidated with it; sometimes the internal malleolus appears to be formed separately: the principal nutritious artery enters at the posterior surface, just below the insertion of the poplitæus muscle.

Muscles attached to the Tibia:

To external surface	*Tibialis anticus.*
external tuberosity	*Extensor longus digitorum.*
inner surface	*Sartorius.* *Gracilis.* *Semitendinosus.* *Semimembranosus.*
posterior surface	*Poplitæus.* *Solæus.* *Tibialis posticus.* *Flexor longus digitorum.*
By the ligamentum patellæ	The *extensors of the leg.*

The *Fibula*, much smaller than the tibia, is divided into a *superior* or *tibial* extremity, a *neck*, a *body*, and an *inferior* or *tarsal* extremity; the *superior extremity*, called also the *head* of the fibula, is round and irregular, and presents on its *inner* side a smooth cartilaginous surface, for articulation with the tibia; from its external and posterior part ascends a long pointed process, which gives attachment to the ligaments connecting the fibula and tibia together, to the external lateral ligament of the knee-joint, and the tendon of the biceps flexor cruris; it is sometimes grooved *posteriorly* for the tendon of the poplitæus muscle. The *neck* of the fibula is that part immediately below the head; it is smooth and round externally where the peroneal nerve winds round it. The *body* or *shaft* of the bone is triangular, especially in its *centre*; it descends obliquely forwards and inwards, so that its lower extremity is on a plane *anterior* and *internal* to the upper; it is twisted like all long bones, and curves a little *outwards*, and may be divided into three surfaces, an *external*, *internal*, and *posterior*, separated by *three ridges*, which are *anterior*, *external*, and *internal*.

The *inferior* or *tarsal* extremity of the fibula is large and more prominent than the superior; it forms a large irregular projection, of a triangular shape, termed the *external malleolus.* Its *outer surface* is rough, convex, and subcutaneous: the *internal*, also convex but smoother, presents *superiorly* a triangular surface for connexion with the tibia; *inferiorly* a smooth articulating surface, a little concave from before backwards, to articulate with the outer surface of the astragalus; and *behind* this, a rough surface into which the posterior fibulo-tarsal and posterior tibio-fibular or transverse ligament are implanted. *Anteriorly* the external malleolus is rough and projecting, and gives origin to ligaments connecting it to the tibia *above*, the tarsus *beneath; posteriorly* it is grooved obliquely downwards and outwards for the passage of the tendons of the peronæus longus and brevis muscles; the apex of the external malleolus is turned downwards, and is placed rather *posteriorly* : the *external lateral ligaments* of the ankle-joint are attached near, but not into it. The fibula articulates with two bones, the tibia and the astragalus; its supply of vessels, structure, etc. are similar to those of the femur and tibia; it has three points of ossification, one for the shaft and one for each extremity. The chief nutritious foramen is seen on the posterior surface, about the middle of the bone.

Muscles attached to the Fibula :

To internal surface	*Extensor communis digitorum.*
	.... *proprius pollicis.*
	Peronæus tertius.
posterior surface	*Solæus.*
	Flexor longus pollicis.
	Tibialis posticus.
external surface	*Peronæus longus.*
	.... *brevis.*
head	*Biceps flexor cruris.*

The *Foot* is divided into the *tarsus*, *metatarsus*, and *phalanges*.

The *Tarsus* occupies the *posterior* half of the foot, and is composed of seven bones; the *astragalus* and *os calcis behind;* the *navicular*, three *cuneiform*, (*internal*, *middle*, and *external*,) and the *cuboid in front.* The Tarsus may thus be divided, like the carpus, into a *posterior* and an *anterior* row of bones.

The *Astragalus*, second in size, is situated in the *superior* and *internal* part of the tarsus, and nearly in its centre, between the tibia *above*, the malleoli *on either side*, the os calcis *inferiorly* and *posteriorly*, and the navicular bone *anteriorly*. It is divided into the *body*, *neck*, and *head:* the *body* of the astragalus occupies the *posterior* part of the bone; *superiorly* it presents a smooth cartilaginous surface, narrower *posteriorly* than *anteriorly*; its *outer* edge higher than its *inner*, for articulation with the tibia; on each side of this is an articulating surface, one *internal*, somewhat pyriform, with its larger extremity *forwards*, for the internal malleolus; the other *external*, triangular with its base above, larger than the *internal*, for the external malleolus. *Inferiorly* the astragalus presents two articulating surfaces; a *posterior* one, large and external, rests on the body of the os calcis *inferiorly;* an *anterior* one internal, much smaller, rests on the sustentaculum of the same bone—these two articular surfaces are separated by a *deep groove*, which only transmits vessels and gives lodgement to ligaments. *Posteriorly* the astragalus is of small extent, and is marked by a deep groove, which gives lodgement to the tendon of the flexor longus pollicis, and into the edges of which the internal lateral ligament of the ankle-joint is implanted.

The *neck* is the most contracted part of the bone, placed in *front* of the body and *behind* the head; it is exceedingly rough and porous for the transmission of vessels, and is not marked by any articular surface; the *head* of the astragalus is placed in front of the neck, directed obliquely forwards and inwards; it is marked *anteriorly* by an oblong articular surface, which is received into the os naviculare in front, and is prolonged *inferiorly* into an articular surface, which is supported by the calcaneo-navicular ligament. The astragalus articulates with four bones: the tibia *above* and *internally*, the fibula *externally*, the os calcis *inferiorly*, and the os naviculare *anteriorly*. No muscle is attached to this bone.

The *Os Calcis* is the largest bone of the tarsus, placed between the astragalus, which is superior, and the os cuboides, anterior to it, so situated as to support nearly the whole weight of the body. It presents a large projection posteriorly, named the tuberosity or heel. The particular parts to be noticed are the following: two large articulating surfaces for the astragalus; the smaller of the two is anterior, inferior, and more internal, and rests upon a part which is by some named *sustentaculum* or *small tuberosity*. At the under surface of the bone and posteriorly are two tubercles, the inner one larger; on the outer surface there is a prominent tubercle, which gives attachment to the perpendicular ligament: the inner surface of the bone is concave, forming an arch for the passage of vessels, nerves, and tendons to the foot; anteriorly there is a large cartilaginous surface for articulation with the os cuboides. The os calcis is articulated with only two bones, viz. the astragalus and os cuboides.

The muscles attached to the Os Calcis :

To the dorsal surface	*Extensor brevis digitorum.*
posterior surface	*Plantaris.*
.... by tendo achillis .	*Gastrocnemius.* *Solæus.*
inferior surface, internally .	*Flexor accessorius.* *Abductor pollicis.* *Flexor brevis digitorum.*
.... externally .	*Abductor minimi digiti.*
anteriorly and inferiorly .	*Flexor brevis pollicis.* *Adductor pollicis.*

The *os naviculare* or *scaphoid* bone is situated at the inner side of the foot, presenting internally a hook-like projection, which gives attachment to the tendon of the tibialis posticus and calcaneo-navicular ligament. This bone presents a cup-like cartilaginous surface posteriorly, for articulation with the head of the astragalus; and three articulating surfaces anteriorly, for the cuneiform bones; the inner one is largest, the outer one smallest; on the external aspect there is sometimes seen a small cartilaginous surface for articulation with the os cuboides.

The os naviculare articulates with five bones, viz. the astragalus, cuboid and three cuneiform bones.

Muscle attached :

Tibialis posticus.

The *os cuboides* is situated at the outer side of the foot, larger internally, smaller and shorter externally, where it presents a groove for the passage of the tendon of the peronæus longus. The under surface is divided into two by a ridge, the posterior part of which gives attachment to the calcaneo-cuboid ligament, the anterior lodges the tendon of the peronæus longus; internally there are two articulating surfaces, one, smaller and sometimes wanting, for the navicular, the other for the external cuneiform bone; posteriorly there is a large cartilaginous surface for articulation with the os calcis; and anteriorly a large surface divisible by a slight ridge into two for articulation with the two external metatarsal bones.

The cuboid articulates with four bones, the os calcis, external cuneiform, two metatarsal bones, and sometimes with a fifth, viz. the navicular.

Muscles attached:

Adductor pollicis.
Flexor brevis minimi digiti.

The cuneiform bones are three, *internal*, *middle*, and *external*, and occupy nearly the centre of the foot.

The *internal* cuneiform bone is the largest, and is thickest on its inferior aspect.

It articulates by cartilaginous surfaces with four bones:

anteriorly,	with the metatarsal bone of the great toe.
externally,	with the second metatarsal bone, and with the second cuneiform bone.
posteriorly,	with the navicular bone.

Muscles attached:

Tibialis anticus.
... . posticus.
Peronæus tertius.

The *middle* cuneiform bone is the smallest of the three, and is wedged in between the two others; its dorsal surface is of a quadrangular shape, its apex is turned downwards, towards the sole of the foot.

It articulates by cartilaginous surfaces with four bones:

anteriorly,	the second metatarsal bone.
posteriorly,	the navicular bone.
externally,	the external cuneiform bone.
internally,	the internal cuneiform.

It has the tendon of the tibialis posticus slightly attached to it.

The *external* cuneiform bone, quadrangular on its dorsal surface and rather oblong, is pointed inferiorly towards the sole of the foot. By cartilaginous surfaces it articulates with six bones.

anteriorly,	with the third metatarsal bone.
internally,	with the second metatarsal and middle cuneiform bones.
posteriorly,	with the navicular bone.
externally,	with the cuboid, and more anteriorly with the fourth metatarsal bone.

The muscles attached are:

Flexor brevis pollicis.
Adductor pollicis.
Tibialis posticus, very slightly.

The tarsal bones are composed of spongy tissue, with a layer of compact matter on their surface. They are developed from one point of ossification, excepting the astragalus and os calcis, which have two, and at birth are almost entirely cartilaginous.

The *Metatarsus* consists of five bones, which belong to the class of long bones, each consisting of a posterior or tarsal extremity, and an anterior or phalangeal, which is also named the head.

The upper extremity presents a smooth surface, for articulation with the bones of the tarsus; the head is rounded with its long axis downwards, and just behind this is a prominent ridge, but separated from the smooth surface of the head by a groove; the bodies are flattened laterally, for the lodgement of the interossei muscles.

The 1st metatarsal bone is the shortest and strongest; its superior articulating surface, in shape, somewhat resembles the human ear. It presents a tubercle inferiorly and externally, for the attachment of the peronæus tertius; its anterior extremity is quadrangular, and marked inferiorly by two grooves, separated by a ridge, which give lodgement to the two sesamoid bones. It is articulated with five bones, viz.

internal cuneiform,
second metatarsal,
the first phalanx,
two sesamoid bones.

The 2d metatarsal bone is the longest, and at its upper part is wedged in between the cuneiform bones. It articulates with six bones, viz.

the three cuneiform bones,
first and third metatarsal,
first phalanx of the second toe.

The 3d metatarsal bone is a little shorter than the preceding. It articulates with four bones, viz.

second and fourth metatarsal,
the external cuneiform bone,
first phalanx of third toe.

The 4th metatarsal bone, slightly shorter than the former, has much the same form. It articulates with five bones, viz.

external cuneiform,
cuboid,
third and fifth metatarsal bones,
first phalanx of the fourth toe.

The 5th metatarsal bone projects more posteriorly than any of the others; presenting externally a tubercle, which gives attachment to the tendons of the peronæus tertius and brevis, and to the abductor minimi digiti, and is a guide to Hey's operation on the foot. It articulates with three bones, viz.

the cuboid,
fourth metatarsal bone,
first phalanx of the little toe.

The metatarsal bones are like long bones in structure, spongy at their extremities, compact in the centre, and presenting a medullary canal. They have two points of ossification, one for the head and one for the body.

Muscles attached :

To all these bones	*Interossei.* *Transversalis pedis.*
the first metatarsal bone .	*Tibialis anticus.* *Peroneus longus.*
second	*Adductor pollicis.* *Peroneus longus.*
third	*Adductor pollicis.*
fifth	*Abductor minimi digiti.* *Flexor minimi digiti.* *Peroneus brevis.* .... *tertius.*

The *Phalanges* form the bones of the toes, three to each, excepting the great toe, which has only two; the upper ones are named *metatarsal*, the next *middle*, and the most anterior, *ungual*. The metatarsal phalanges are the longest and largest, concave at the upper extremity, convex at the anterior, rough on their under surface and sides, for the attachment of ligaments, covered by the expansion of the tendons of the extensor muscles, laterally by the tendons of the interossei and lumbricales, and inferiorly grooved for the flexor tendons.

The middle phalanges give attachment laterally and inferiorly to the tendons of the flexor brevis. The middle phalanx may be said to be wanting in the great toe.

The ungual phalanx is small and triangular, largest in the great toe; rough at the anterior extremity, for the attachment of the nail, and the expansion of the tendons of the extensor longus and flexor longus digitorum.

The first phalanx belongs to the class of long bones, the others consist chiefly of spongy tissue; they are generally developed from one ossific centre.

Muscles attached:

To great toe.	
First phalanx . . .	*Extensor brevis digitorum.* *Flexor brevis pollicis.* *Abductor pollicis.* *Adductor* ... .
Second phalanx . . .	*Extensor proprius pollicis.* *Flexor longus* ....
first phalanx of four smaller toes	*Interossei.* *Lumbricales.*
second phalanx of the four smaller toes	*Flexor digitorum sublimis.*
third phalanx of the four smaller toes	*Flexor digitorum profundus.* *Extensor longus digitorum.* .... *brevis* ....
To the little toe	*Adductor minimi digiti.* *Flexor* .... *Abductor* ....

THE ARTICULATIONS OF THE LOWER EXTREMITY.

The articulations of the lower extremity consist of the *hip-joint*, or *ilio-femoral articulation;* the *knee-joint*, the *superior* and *inferior tibio-fibular articulations*, the *ankle-joint*, and the *articulations of the foot.*

THE HIP-JOINT.

This articulation is formed by two bones, the *os innominatum* and the *femur.*

The *Os Innominatum* presents in its contracted part an excavation termed the acetabulum, which receives the head of the femur; it is a deep, cup-like cavity, nearly circular in shape, and surrounded by a projecting lip of bone, strong and prominent towards its *upper* and *back* part, projecting but little *anteriorly*, where it is formed by the os pubis, and altogether deficient *internally* and *inferiorly* towards the thyroid foramen, where it presents a deep notch, converted by the cotyloid ligament into a foramen, which serves for the transmission of vessels to supply the head of the femur; its cavity is lined by cartilage, except at the *anterior inferior* part, where we see a rough irregular surface for giving origin to the ligamentum teres, and lodgement to a quantity of fatty substance, formerly called Haversian glands. This cartilage is thicker at the *superior* part of the acetabulum, where it rests on the upper surface of the head of the femur, and is of much greater depth at the circumference than in the centre, like all cartilages lining concave surfaces: the depth of this cavity is from an inch to an inch and a half.

The parts of the *Femur* which assist in forming this articulation are the *head* and part of the *neck*. The *head* of the femur is of a somewhat spherical shape, covered by cartilage, and forming about two thirds of a sphere; the cartilage extends more *outwardly* on its superior than its inferior surface: nearly in its centre, but a little posterior and inferior to it, is a depression for receiving the insertion of the ligamentum teres. The *neck* of the femur *superiorly* is of short extent, and concave for the purpose of allowing of abduction of the femur; inferiorly it is also excavated, but is much longer: the *anterior* surface of the neck of the femur is nearly plane, and presents numerous foramina for the transmission of blood-vessels: the *posterior* surface is deeply excavated to allow of rotation outwards, is much more extensive than the anterior, is rough from the passage of blood-vessels, and gives insertion about its centre to the capsular ligament. The neck differs in the *female* subject: it is much longer and more rounded, not so triangular, and is directed more horizontally. In the *old subject* it becomes horizontal, is shortened considerably, and undergoes a process of interstitial absorption, which removes most of its animal matter, and thus gives rise to its being frequently fractured at this period of life: in the young subject it hardly exists.

THE LIGAMENTS OF THE HIP-JOINT.

The *ligaments* of the hip-joint are the *capsular* and the *accessory* ligaments, situated *externally;* the *cotyloid ligament* and *ligamentum teres, internally*.

The *capsular ligament* is by far the strongest and most perfect ligament of the kind in the human body; it arises *superiorly* from the outer surface of the brim of the acetabulum beyond the cotyloid ligament, passes from this downwards and outwards, envelops the head of the bone, and is inserted into the neck which it closely embraces, extending *anteriorly* as far as the anterior inter-trochanteric line; but *posteriorly* only as far as about three fourths of an inch, from the posterior inter-trochanteric line; which explains how fracture of the neck of the femur can occur partly within and partly without the capsular ligament. This ligament is strong and thick anteriorly, and is also strengthened by the tendinous origin of the rectus femoris muscle, and the accessory ligament; it is thin and weak towards the thyroid foramen; it is perforated by the tendon of the rectus femoris muscle; on its *external* surface it is covered by numerous muscles which assist in strengthening the joint; on its inner surface it is lined by synovial membrane.

The *accessory ligament* is situated on the *anterior* part of the joint; it arises from the inferior spinous process of the ilium, expands, passes downwards and backwards, and is inserted into the lesser trochanter; it strengthens the articulation in front, supports the head of the femur, and prevents too great extension of the joint; it is covered by the psoas magnus and iliacus internus muscles *anteriorly*, from which it is separated by a large bursa which sometimes communicates with the joint; *posteriorly* it is identified with the capsular ligament.

The *ligamentum teres*, or *inter-articular* ligament, arises from the rough surface in the bottom of the acetabulum by two heads, one from each side of the notch in its circumference: it passes upwards and outwards, and is implanted into the depression in the head of the femur. Its two heads are separated by the vessels passing to the head of the bone, branches of the obturator and internal circumflex arteries, the conducting of which seems to be its principal use.

The *cotyloid ligament* surrounds the brim of the acetabulum to which it is firmly attached; it is deeper at the upper and back part of the acetabulum than elsewhere; its *structure* is fibro-cartilaginous, its fibres running obliquely towards the bone; it is continuous with the tendon of the rectus femoris muscle, and is lined by synovial membrane; its *use* is to deepen the cavity of the acetabulum without interfering with the motion of the joint.

A few fibres pass in a transverse direction, across the notch beneath the cotyloid ligament, which have received the name of *transverse* ligament; they are seldom so distinct as to deserve a separate name; they are intimately connected with the cotyloid ligament.

The *interior* of the hip-joint is lined by a *synovial membrane*, which covers the head of the bone, part of its neck, lines the capsular ligament, and is reflected upon the round ligament. Like similar membranes it forms a shut sac.

The hip-joint belongs to the class of *Enarthrodial*, or *ball-and-cup* articulations; its motions are very extensive, and comprise *flexion*, *extension*, *abduction*, *adduction*, *rotation*, and *circumduction*.

THE KNEE-JOINT.

The *knee-joint* is formed by three bones: the *femur* above, the *tibia* beneath, and the *patella* in front.

The *femur* presents for the purpose two oval convex eminences, termed *condyles*, elongated in the antero-posterior direction, and incrusted with cartilage.

The superior extremity of the *tibia* which assists in forming the joint is of an oval shape, elongated transversely, and is marked with two concave articular surfaces, for the reception of the condyles of the femur, and corresponds with them; they are also termed *internal* and *external condyles*.

The part of the *patella* which enters into this articulation is its *posterior* surface; this is triangular in shape; the apex inferiorly, the base superiorly; it is lined by cartilage, and is divided by a nearly vertical ridge into an external and internal part, which correspond with the external and internal condyles.

THE LIGAMENTS OF THE KNEE-JOINT.

The ligaments of the knee-joint are divided into external and internal.

The external ligaments are the

ligamentum patellæ,
external and internal lateral ligaments,
ligamentum posticum of Winslow.

The internal are the

two alar ligaments,
ligamentum mucosum,
transverse ligament,
two crucial ligaments,
ligament of Wrisberg.

This articulation is strengthened by an aponeurotic expansion, derived from the fascia lata, and the vasti muscles; which is much stronger *externally* than *internally*, and passes inferiorly in a transverse direction across the ligamentum patellæ, which it here binds firmly down; on raising this we bring into view, in front of the patella, the parietes of a large bursa mucosa which covers the anterior surface of this bone, and is interposed between it and the expansion from the extensor tendons; below this is a very small and indistinct bursa in front of the ligamentum patellæ.

The *ligamentum patellæ* arises from the apex of the patella, passes downwards and outwards, and is inserted into the lower part of the *tubercle* of the tibia; it is from two to three inches in length, narrow in the centre, expanded at either extremity; its *outer* edge is better defined and longer than the *internal;* a large bursa separates it from the smooth surface on the upper extremity of the tibia, and the superior part of the tubercle. Although called ligament, it is more properly a tendon;

originally it was the continuation of the rectus femoris tendon, the patella being developed in its structure, to obviate the effects of friction; like tendons, it is smooth and polished, and its fibres are longitudinal.

The *external lateral ligament* is a round fibrous chord; it arises *superiorly* from an eminence on the external condyle of the femur, immediately above the depression for the poplitæus tendon, passes *downwards*, a little *backwards* and *outwards*, and is inserted into the upper extremity or head of the fibula, between the tendinous insertions of the biceps flexor cruris; there is sometimes a second external lateral ligament, situated posterior to the first; it is much smaller, arises from the fibula, passes upwards, and is inserted either into the external semilunar cartilage, or into the external condyle of the femur; on its *outer* surface the external lateral ligament is covered by a tendinous aponeurosis, derived from the vastus externus muscle and fascia lata; it is separated from the external semilunar cartilage by the external inferior articular artery.

The internal lateral ligament is a broad flattened band, attached superiorly to the eminence on the inner surface of the internal condyle; it passes downwards and forwards, and is inserted into the inner surface and anterior edge of the upper extremity of the tibia; this ligament is from three to four inches in length, and from an inch to an inch and a half in breadth; it is continuous *superiorly* with the adductor magnus tendon; is expanded *in the centre*, where it intimately adheres to the internal semilunar cartilage; is narrow, and pointed *inferiorly*; its *anterior* edge is well marked; its *posterior* edge is gradually lost in the posterior part of the joint; its *cutaneous* *surface* is covered by the tendons of the sartorius, gracilis, and semitendinosus.

The ligamentum posticum of *Winslow* is placed in an oblique direction at the posterior part of the joint, filling up the posterior intercondyloid fossa; it is implanted inferiorly into the internal and posterior part of the tibia, passes upwards and outwards, and is inserted into the external condyle of the femur; it is perforated by the azygos artery, a branch of the poplitæal, and may be considered as being derived from, and forming one of the insertions of, the semimembranosus muscle; its *posterior* surface has resting on it the poplitæal artery, from which it is separated by a lymphatic gland; its *anterior* surface corresponds with the articulation.

The internal ligaments are the following:

The *two alar ligaments* are folds of the synovial membrane; they arise on either side of the patella, pass downwards, converge, and form an angle, from which arises the following ligament.

The *ligamentum mucosum* arises from the angle formed by the preceding, passes upwards and backwards, and is inserted into the depression between the condyles of the femur; it is exceedingly small and weak, and is sometimes wanting.

The *transverse ligament* is situated in front of the anterior extremities of the semilunar cartilages, passing from one to the other, occasionally wanting; its use is to connect the two cartilages together, so as to prevent their separation when the femur rests on their superior surface.

The *crucial ligaments* are two in number: an *anterior* and *posterior*; and may be seen stretching obliquely from the femur to the tibia, in the centre of the joint; they are called crucial, from their crossing one another, and have received their names of anterior and posterior from their attachment to the *tibia.*

The *anterior crucial ligament* arises superiorly from the internal surface and posterior part of the external condyle of the femur, passes downwards, forwards, and inwards, and is inserted into the rough surface in front of the spine of the tibia, and into the anterior extremity of the *internal* semilunar cartilage.

The *posterior crucial ligament* arises *superiorly* from the external surface and posterior part of the internal condyle of the femur, passes downwards, backwards, and outwards, enlarging as it descends, and is inserted into the rough surface behind the spine of the tibia, and into the posterior extremity of the *external* semilunar cartilage. Their use is, besides connecting the femur, tibia, and cartilages, to resist inversion of the foot, or eversion of the thigh; when the other ligaments of the joint are cut across, these will be found to become unfolded on turning the foot outwards.

The *ligament of Wrisberg* is an irregular band of fibres, most frequently wanting; when present, it stretches from the posterior extremity of the external semilunar cartilage to the internal condyle of the femur.

The *two semilunar* or *inter-articular* cartilages are oval-shaped, flattened bodies, of a fibro-cartilaginous structure, placed between the condyles of the femur and the tibia, but more intimately connected to the latter than the former; they are called *external* and *internal.*

The *external semilunar cartilage* is somewhat circular; it is shorter from before backwards than the internal, but is wider transversely; its *anterior* extremity is implanted into the rough surface in *front* of the spine of the tibia; its *posterior* extremity is inserted into the rough surface *behind* the spine; its *outer edge* corresponds to the tendon of the poplitæus muscle, and to the external inferior articular artery, which intervenes between it and the external lateral ligament.

The *internal semilunar cartilage* is oval in shape, and longer than the external; has its *anterior* extremity attached to the rough surface in front of the spine of the tibia; its *posterior* extremity is inserted into the rough surface behind the spine, its *outer* edge is firmly connected to the internal lateral ligament. These cartilages, like the crucial ligaments, differ in almost every particular, as may be collected from the preceding description. The *use* of the cartilages is to present a deep excavation for the reception of the condyles of the femur, to adapt themselves to the different surfaces of the femur in contact with them in flexion and extension, and to lessen the effects of shocks; the *internal* one, although more fixed, is more liable to displacement than the *external:* we may explain this, by the greater weight of the joint being thrown on the inner side, in consequence of the oblique direction of the femur and the greater depth of the internal condyle, and by the fact of its being more fixed, preventing it from following the condyle of the femur so completely as the external.

The *synovial membrane* is the most extensive in the body, and the most liable to disease; it lines the joint generally, is reflected upon both surfaces of the cartilages, and ascends a considerable distance upon the anterior surface of the femur, and only covers the crucial ligaments partially.

The *knee-joint* belongs to the class *imperfect Angular Ginglymus*. Its motions are *flexion*, *extension*, and *slight lateral motion* in the flexed position.

Slight lateral motion is enjoyed in the *flexed* position of the joint, as when one limb is thrown across the other; it is favoured by the ligaments becoming relaxed, and by the round surfaces on the posterior part of the condyles of the femur corresponding to the semilunar cartilages; this motion is useful in progression, as we are thus enabled more effectually to turn the foot outwards; it is altogether wanting in the extended position, because then the greatest weight is thrown on the joint, and any lateral motion would render it insecure.

THE SUPERIOR PERONÆO-TIBIAL ARTICULATION.

This articulation is formed by two bones, the *tibia* and *fibula*; they are connected by two ligaments, the *anterior* and *posterior peronæo-tibial*, and a synovial membrane.

The *anterior peronæo-tibial* ligament arises from the anterior part of the head of the fibula, passes upwards and inwards, and is inserted into the anterior surface of the tibia.

The *posterior peronæo-tibial* ligament has a similar origin and insertion to the anterior; it is not so strong as the anterior; the *interior* of the joint is lined by synovial membrane, which is either in close contact with that of the knee-joint, or communicates with it along the tendon of the poplitæus muscle; it belongs to the class Arthrosis; its motions are very trifling.

The *Tibia* and *Fibula* are connected in the *centre* of the leg by a strong fibrous structure, termed the *interosseous membrane*, or ligament; this, more extensive above than below, fills the interval which exists between the two bones, and gives origin to several muscles. *Superiorly*, this membrane is deficient, and leaves a large interval through which the anterior tibial artery, some branches of nerves, and a few fibres of the tibialis posticus muscle pass; *inferiorly*, it also leaves a passage, but much smaller, for the anterior branch of the fibular artery; in the *centre* are many foramina for the transmission of vessels. Its *anterior surface* is covered by the *tibialis anticus*, *extensor longus digitorum*, *extensor proprius pollicis*, and *peronæus tertius muscles*, to all of which it affords origin; its *posterior surface* is covered by the *tibialis posticus* and *flexor longus pollicis* muscles, which also arise from it.

THE INFERIOR PERONÆO-TIBIAL ARTICULATION.

This articulation, closely connected with the ankle-joint, is formed by the convex surface of the *fibula* and the concave surface of the *tibia*, united by two ligaments, the *anterior* and *posterior peronæo-tibial* ligaments, and a strong *interosseous structure*, resembling fibro-cartilage.

The *anterior peronæo-tibial* ligament arises *inferiorly* from the anterior part of the lower extremity of the fibula, passes upwards and inwards, and is implanted into the anterior surface of the tibia.

The *posterior peronæo-tibial* ligament is similar to the preceding, and is not so well marked as the anterior. The tibia and fibula are also held firmly together by a strong interosseous structure, resembling fibro-cartilage; it will be found to attach itself firmly on either side to the bones above their cartilaginous surface. The lower part of this articulation is lined by cartilage and synovial membrane, which are continuous with those of the ankle-joint. This joint may be said to belong to *Amphiarthrosis*; it possesses no motion.

THE ANKLE-JOINT.

This articulation is formed by three bones; the *tibia* and *fibula*, *superiorly*, the *astragalus*, *inferiorly*.

THE LIGAMENTS OF THE ANKLE-JOINT.

The ligaments of the ankle-joint are,

internal lateral,
external lateral,
anterior and posterior tibio-tarsal,
posterior tibio-fibular.

The *internal lateral* or *deltoid* ligament is covered by the tendons of the *tibialis posticus* and *flexor communis muscles*, the *posterior tibial artery*, *nerve*, &c.; it arises *superiorly* from the inferior edge of the internal malleolus along its whole extent: from this its fibres pass in a radiated manner; the *anterior* are inserted into the under surface of the os naviculare, the middle pass directly downwards to be inserted into the inner part of the astragalus, where they form a fibrous canal, through which the tendon of the flexor longus pollicis runs, and into the sustentaculum of the os calcis: the *posterior* fibres are inserted also into the astragalus and os calcis; this ligament is broad, strong, and expanded, like internal lateral ligaments in general, in order to support the weight of the body thrown obliquely on it, in consequence of the obliquity of the superior articular surface of the astragalus.

The *external lateral ligaments* are three in number, the *anterior*, *middle*, and *posterior*.

The *anterior* ligament arises from the anterior edge of the external malleolus, passes almost horizontally forwards and inwards, and is inserted into the rough surface on the upper and outer part of the neck of the astragalus.

The *middle external lateral* ligament arises from near the apex of the external malleolus, passes downwards, backwards, and inwards, and is inserted into a tubercle on the outer surface of the os calcis: it has also received the name of perpendicular ligament; the tendons of the peronæus longus and brevis wind round its *outer* surface.

The *posterior external lateral*, or *posterior peronæo-tarsal* ligament, arises from the inner surface of the external malleolus, passes horizontally backwards and inwards, and is inserted into the rough surface on the posterior part of the astragalus.

The *anterior tibio-tarsal* ligament arises from the anterior surface of the tibia, and is implanted into the upper part of the neck of the astragalus; it is a weak, indistinct ligament; the synovial sheath investing the extensor tendons frequently communicates with the ankle-joint through a deficiency in this ligament.

The *posterior tibio-tarsal* ligament is placed at the posterior part of the joint, and is still more indistinct.

The *posterior tibio-fibular* ligament. This ligament is situated at the posterior part of the ankle-joint; it stretches from the outer surface of the internal malleolus transversely across, to be implanted into the inner surface of the external malleolus; it is sometimes but badly marked; this ligament might be called the cotyloid ligament of the ankle-joint; its use is to deepen the articular cavity without interfering with the motion of the joint; its *struc-*

ture approaches to fibro-cartilage; it is lined by the synovial membrane.

The *interior* of the ankle-joint is lined by synovial membrane, which invests the cartilaginous surfaces of the bones, and passes up a short distance between the tibia and fibula.

The ankle-joint belongs to the class of *Angular Ginglymus* (imperfect); its motions are *flexion*, *extension*, and *slight lateral motion* in the extended position of the foot.

THE ARTICULATIONS OF THE FOOT.

The articulations of the foot may be classed into those of the *tarsus*, *metatarsus*, and *phalanges*.

THE ARTICULATIONS OF THE TARSUS.

The *articulations and bones of the Tarsus* are united by numerous ligaments, named from the bones to which they are attached, and situated chiefly on the dorsum, and in the sole of the foot; they are hence divided into the dorsal and plantar ligaments; there are but few of them of such importance as to require a very detailed description, consisting of bands of fibres passing from one bone to another. The principal are the *calcaneo-navicular* and the *calcaneo-cuboid*, or *ligamentum longum*, both plantar ligaments. The dorsal ligaments are much weaker than the plantar.

The *calcaneo-navicular ligament* is situated at the inner part of the foot, where it is concealed by the tendon of the tibialis posticus muscle, which lies immediately beneath it; it is attached *posteriorly* to the anterior part of the sustentaculum of the os calcis, passes forwards and inwards, and is inserted *anteriorly* into the under surface of the navicular bone; the *inferior* surface of this ligament is covered by the tibialis posticus tendon; its *superior* is lined by synovial membrane, where it supports the head of the astragalus without being attached to it; its *structure* is fibro-cartilaginous, or even sometimes bony, particularly in its centre, where it lies between the tendon inferiorly and the bone superiorly; its principal use is to support the head of the astragalus, for which purpose it possesses much elasticity.

The *calcaneo-cuboid ligament* or *ligamentum longum* is the longest and most powerful of the ligaments of the foot; it arises from the posterior and inferior part of the os calcis, passes forwards, and is inserted first into the tubercle on the under surface of the cuboid bone, then assists in forming the tendinous sheath for the peronæus longus tendon, and finally is implanted into the base of the metatarsal bones, spreading out and mixing its fibres with the ligaments which connect these together; it lies deep in the sole of the foot.

Between the bones will be met with, occasionally, interosseous ligaments of a strong fibrous nature: the most remarkable of these are, one which is lodged in the deep groove in the under surface of the astragalus, connecting it to the os calcis, and another between the navicular and cuboid bones. The various articulations of the tarsus are lined by a synovial membrane.

The *astragaleo-navicular* is the most moveable articulation in the foot as may be inferred from the nature of the articular surfaces of the bones: it enjoys almost every motion, though in a slight degree, and is lined by a distinct synovial sac; it is through it, that Chopart's amputation of the foot is performed.

THE METATARSAL ARTICULATIONS.

The metatarsal and phalangeal articulations are of a very simple character; in addition to the tendinous expansions covering them, they are strengthened by lateral ligaments, and are lined by a synovial membrane. Their chief motions are flexion and extension.

The structure of the foot is such as is best adapted for its intended use. It supports the weight of the whole body, and at the same time enjoys much motion, and some elasticity. It presents two arches: one transverse, smaller; the other, larger, is directed from behind forwards. Of the latter, the points of support are posteriorly the tuberosity of the os calcis; anteriorly, the metatarso-phalangeal articulations: this arch is most evident on the inner side of the foot. In addition to the strength thus obtained, the arched state is also useful in giving lodgement to the principal vessels, nerves, &c., which run along the under part. Mr. Abernethy compared the foot to a tripod, the three points of support being, one posteriorly at the os calcis, anteriorly at the ball of the great toe, and externally at the projecting base of the fifth metatarsal bone; the last, however, seldom touches the ground.

THE UPPER EXTREMITIES.

The *upper extremities* may be divided each into the *shoulder*, *arm*, *fore-arm*, and *hand*.

THE BONES OF THE UPPER EXTREMITIES

Consist of the *clavicle* and the *scapula*, which are those of the *shoulder*, the *humerus* or bone of the arm, the *radius* and *ulna*, which constitute the *fore-arm*, and the bones of the hand, which are divided into those of the *carpus*, *metacarpus*, and *phalanges*. The carpal bones are eight in number, viz. the *os scaphoides* or *naviculare*, *lunare*, *cuneiforme* or *pyramidale*, *pisiforme*, *trapezium*, *trapezoides*, *magnum*, and *unciforme*. The metacarpal bones are five in number, one for each finger; the *phalanges* are like those of the foot, fourteen in number, three for each finger and two for the thumb.

BONES OF THE SHOULDER.

The *clavicle*, or *collar-bone*, extends from the sternum to the scapula; it is divided into its *sternal* and *scapular extremities*, and its *body* or *shaft*.

The *sternal*, or *anterior* extremity of the clavicle, is thick, strong, and triangular; it is marked by a cartilaginous surface, for articulation with the sternum; its edges give attachment to ligaments; from this the *body* of the clavicle passes upwards, backwards, and outwards, covering the first rib and coracoid process of the scapula, curved on itself so as somewhat to resemble an italic *S*, having its convexity first turned *forwards* and then *backwards;* near the *sternum* it gives attachment to the clavicular position of the pectoralis major muscle, by its posterior concave portion to the sterno-cleido mastoid.

Inferiorly it presents a rough surface, for the insertion of the rhomboid ligament. In the *centre* the clavicle becomes smooth, circular, and contracted, and gives origin to no muscular fibres; it is here that the two curves, of which the bone is composed, meet, and that fracture is so frequent; its under surface is rough, for the attachment of the costo-clavicular ligament; towards its *scapular*, or *acromial extremity*, the clavicle becomes flattened superiorly and inferiorly, and gives attachment by its *anterior* concave edge to the deltoid muscle, by its *posterior* convex edge to the trapezius; inferiorly it is rough, and marked by a groove for the insertion of the subclavius muscle; in this part is the foramen for the nutritious artery of the bone; external to this is a rough surface, for the insertion of the conoid and trapezoid ligaments.

The *acromial* end has its superior and inferior surfaces rough, for the attachment of ligaments connecting it to the acromion process; it is marked at its outer edge by an articular surface. The clavicle articulates with only two bones, the sternum and scapula.

The *use* of the clavicle is to keep back the shoulder and connect the scapula to the trunk, being their only bony connexion; it also protects the subclavian artery and vein, and brachial plexus of nerves, from injury: its medullary canal is not well marked.

In the female the clavicle is longer and less curved than in the male; it is also much smaller and more circular in shape. In the *fœtus* it is the first bone developed, appearing so early as the sixth week; it has three points of ossification, one for the body and one for each extremity; that for the body appears much sooner than the others.

Muscles attached to the Clavicle :

Sterno-mastoideus.
Subclavius.
Pectoralis major.
Deltoides.
Trapezius.

The *Scapula* is placed at the *posterior* and *upper* part of the trunk, extending from the *first* to the *seventh* rib; it is of a triangular shape, and is divided into *two surfaces*, an *anterior* and *posterior ;* three edges or borders, a *superior*, a *posterior* or *vertebral*, and an *inferior* or *axillary*; and *three angles*, which are *posterior*, *inferior*, and *anterior*.

The *anterior surface* of the scapula, called also the subscapular fossa, is directed towards the thorax ; it is excavated to accommodate the convexity of the ribs, on which it rests, and to give lodgement to the subscapular muscle ; it is marked by three, four, or five oblique ridges, which run downwards and backwards ; between these ridges the bone is thin and transparent ; at the posterior part of the fossa, near the superior and inferior angles, it is smooth, for the insertion of the serratus magnus muscle.

The *posterior surface* or *dorsum* of the scapula is divided unequally into two portions, a *superior* and *inferior*, by a ridge of bone, termed the spine ; the *superior* part, called the *supra-spinous fossa*, is much smaller than the inferior ; it gives lodgement to the supra-spinatus muscle : the *inferior* part, called the *infra-spinous fossa*, affords origin to the infra-spinatus muscle ; at its lower part, near the axillary border of the scapula, it becomes thick and elevated, and forms a somewhat flat surface, marked by two ridges ; this is broad and quadrilateral inferiorly, where it gives origin to the teres major muscle, narrow and triangular superiorly, where the teres minor arises. The *spine* of the scapula is triangular in shape; it commences near the posterior edge of the scapula, by a triangular smooth surface, over which passes the tendon of the trapezius muscle, and from which it is separated by a bursa; from this the spine ascends outwards and forwards, inferiorly gives origin to the deltoid muscle, superiorly to the insertion of the trapezius, and terminates in the *acromion process;* this is a projection of bone, flattened superiorly and inferiorly, which overhangs the shoulder-joint; anteriorly it is marked by an oblong articular surface, which articulates with and supports the clavicle; the external edge is convex, and gives origin to the deltoid muscle. In general two or three foramina, for the passage of vessels, may be observed at the root of the spine.

The *superior border* of the scapula is the shortest of the three; at the junction of its anterior and middle third is a notch converted into a foramen by the posterior proper ligament, which gives transmission to the supra-scapular nerve, the artery of the same name in general passes above this ligament; in front of the notch arises a long irregular eminence, termed the *coracoid process;* this occupies, at its root or origin, the remaining part of this edge as far as about a line from the glenoid cavity; its upper surface, rough, gives attachment to the conoid and trapezoid ligaments, and a few fibres of the omohyoid muscle; its under surface is smooth and concave; its internal edge gives insertion to the pectoralis minor; its external, to the coraco-acromial ligament; from its point arise the coraco-brachialis muscle and short head of the biceps: it serves as a protection to the shoulder-joint, which it overhangs towards its internal side.

The *posterior* or *vertebral border*, or *base* of the scapula, is turned backwards and inwards towards the spine, to which it is nearer superiorly than inferiorly; it gives attachment to several muscles.

The *inferior* or *axillary* border is shorter but stronger than the preceding; it extends from the inferior angle to the glenoid cavity.

The *posterior angle* of the scapula is that formed by the junction of the superior and posterior edges; it is rounded off, and gives insertion to the levator anguli scapulæ.

The *inferior angle* is formed by the junction of the posterior and axillary borders; it is more acute than the posterior, and is covered by the origin of the teres major muscle and the latissimus dorsi.

The *anterior angle* is formed by the junction of the superior and axillary borders; it presents a superficial concave articular surface, ovoid in shape, its long axis directed vertically, large inferiorly, narrow and pointed superiorly, for articulating with the humerus, and forming the shoulder-joint; it is termed the *glenoid cavity*, is surrounded by a ridge of bone, and by the cotyloid ligament, and is supported by the *anatomical neck*, which is that portion situated behind the edge of the cavity, and in front of the root of the coracoid process: this gives origin to the capsular ligament of the shoulder-joint, and is called anatomical, to distinguish it from the surgical neck, where fracture sometimes occurs; this is posterior to the root of the coracoid process, and passes through the notch in the superior border. The scapula articulates with but two bones, the clavicle and humerus: its mode of connexion with the trunk is termed sysarcosis.

Muscles attached to the Scapula:

Spine and acromion	*Deltoides.* *Trapezius.*
coracoid process	*Biceps* (short head). *Pectoralis minor.* *Coraco-brachialis.*
edge of glenoid cavity	*Biceps* (long head).
superior border	*Omo-hyoid.*
posterior border	*Rhomboideus major.* .... *minor.* *Serratus magnus.*
posterior angle	*Levator anguli scapulæ.*
inferior angle	*Latissimus dorsi.*
inferior border	*Triceps* (long head). *Teres major.* .... *minor.*
supra-spinous fossa	*Supra-spinatus.*
infra-spinous	*Infra-spinatus.*
subscapular fossa	*Subscapularis.*

THE HUMERUS.

The *Humerus*, or *os-humeri*, belongs to the class of long bones, and may be divided into its *upper extremity* or *head, its neck, body*, or *shaft*, and *lower extremity*. The *head* is a round hemispherical convex eminence, incrusted with cartilage, and forms with the glenoid cavity of the scapula the shoulder-joint; it is connected to the shaft of the bone by the *anatomical neck* of the humerus, a rough irregular depression immediately external to the head, narrow superiorly, wide and expanded inferiorly, which gives insertion to the capsular ligament of the joint: the head is placed on the posterior and inner part of the bone, the shaft of which it joins so as to form an obtuse angle inferiorly. External, and anterior to the neck, we observe two eminences, a larger and smaller, separated by a groove: they are called the *tuberosities* of the humerus, the larger being the *external* or *posterior;* the smaller, the *internal* or *anterior.* The former of these is placed on the outer side of the bone, is round and marked by three flat surfaces: a superior, middle, and inferior, for the attachments respectively of the supra-spinatus, infra-spinatus, and teres minor muscles. The smaller tuberosity is situated towards the inner side, is sharp and more projecting, and gives attachment to but one muscle, the subscapularis: these tuberosities may be compared to the trochanters of the femur. The groove which separates them is called the *bicipital groove*, because in it is lodged the long tendon of the biceps; it is bounded on either side by two ridges, termed the *inner* or *posterior*, the *outer* or *anterior* edges of the bicipital groove, which give attachment to muscles. Immediately below the tuberosities, the humerus becomes contracted, and terminates in the shaft of the bone; this extends from the tuberosities to the inferior extremity; its upper third is round and strong, and has received the name of the *surgical neck*, as it is here that fracture so frequently takes place, to distinguish it from the anatomical neck already alluded to; its middle third is irregularly twisted, and of a triangular shape; its inferior becomes expanded and flattened anteriorly and posteriorly, and about the centre of the internal surface of the bone is the nutritious foramen directed downwards and outwards, surrounded by a rough surface, into which is implanted the coraco-brachialis muscle. The surfaces of the humerus are separated by three ridges, an *anterior*, *internal*, and *external.* The *inferior extremity* of the humerus is turned forwards and inwards, becomes elongated transversely, flattened anteriorly and posteriorly, and terminates in forming the articular surfaces, for the reception of the radius and ulna; its anterior surface, which also looks inwards, is convex, and is marked inferiorly by the *anterior humeral fossa*, which receives the coronoid process of the ulna in *flexion* of the elbow-joint; the posterior surface turned outwards is more extensive, concave, and marked by a deeper depression, the *posterior humeral fossa* which receives the olecranon in extreme extension of the joint; *externally* we observe a process, in which terminates the external ridge of the bone, termed the *external condyle;* this is placed on a plane, anterior to the internal condyle, and gives origin to the external lateral ligament of the elbow, and most of the extensors and supinators of the fore-arm; as we pass from this *internally*, we meet with the *capitulum*, or *lesser head* of the humerus, a rounded, convex, articular eminence, which is received into the cup-like cavity of the radius, and is bounded anteriorly by a depression for receiving the radius in flexion of the joint; internal to this is a depression for receiving the projecting lip of the same bone; still more internally, and separated from it by a slight projection of the bone, is the *trochlea*, a large articular surface, concave from side to side, convex from before backwards, bounded in front and behind by the anterior and posterior humeral fossæ, and articulated with the great sigmoid cavity of the ulna; this is bounded internally by a prominent ridge of bone which descends considerably below the rest of the humerus, and is termed the *epitrochlea;* internal to this is a rough depression, and most internally the *internal condyle*, a sharp triangular process of bone, directed backwards and inwards, and placed on a plane posterior and superior to the external, and much more projecting than it; it gives attachment to the internal lateral ligament, and most of the flexor and pronator muscles; the lower extremity of the bone is turned forwards and inwards, so that the fore-arm may be thrown across the chest in flexion of the elbow-joint. The humerus is developed by several points of ossification, one each for the head, tuberosities, body, the condyles, the trochlea, and the lesser head; it *articulates* with three bones, the scapula, the radius, and ulna.

Muscles attached to the Humerus:

To great tuberosity	*Supra-spinatus.* *Infra-spinatus.* *Teres minor.*
small tuberosity	*Subscapularis.*
anterior surface	*Deltoides.* *Brachialis anticus.* *Coraco-brachialis.*
posterior edge of bicipital groove	*Teres major.* *Latissimus dorsi.*
anterior	*Pectoralis major.*
posterior surface	*Triceps.*
external border	*Supinator radii longus.*
external condyle	*Extensor carpi radii longior.* .... *brevior.* .... *communis digitorum.* .... *carpi ulnaris.* .... *minimi digiti.* *Anconæus.* *Supinator radii brevis.*
internal condyle by common tendon	*Pronator radii teres.* *Flexor carpi radialis.* .... *ulnaris.* .... *sublimis digitorum.* *Palmaris longus.*

THE BONES OF THE FORE-ARM.

The bones of the fore-arm are the *radius* and *ulna*.

The *Radius* is situated on the outer and anterior part of the fore-arm; it is shorter than the ulna, but extends beyond it inferiorly to form the wrist-joint; it is small and rounded superiorly, and expands considerably, is flattened, and quadrilateral inferiorly: it may be divided into the *head*, *neck*, *tubercle*, *body*, and *lower extremity*. The *head* of the radius is circular and concave, incrusted with cartilage, and forms a cup-like cavity to receive the capitulum of the humerus; it is surrounded by a projecting lip of bone, covered also by cartilage; expanded internally, where it corresponds to the lesser sigmoid cavity of the ulna; more narrow and prominent externally, where it is surrounded by the annular or orbicular ligament: beneath this is the *neck* of the radius, small, circular, and contracted, about an inch in length, and encircled partially by the annular ligament; beneath it, and on the internal anterior part of the radius, is the *tubercle*, rough posteriorly, where it gives insertion to the tendon of the biceps; smooth anteriorly, where it is covered by a bursa, which separates it from this tendon; the *body* of the radius descends from this, and presents *three surfaces*, an *anterior*, *posterior*, and *external*, separated by as many ridges; the *anterior surface*, concave, broad, and expanded inferiorly, gives attachment to muscles; at the junction of its upper and middle third, and to its outer side, it presents the foramen for the nutritious artery directed upwards; the *external surface* is convex, rounded, and arched outwards; the *posterior surface* is convex superiorly, concave in the centre, and convex inferiorly, where it is covered by the extensor tendons.

Of the *three ridges*, the *internal* is the best marked; it gives attachment to the interosseous ligament: the anterior and posterior are indistinct.

The *inferior*, or *carpal extremity* of the radius, is the largest part of the bone; it is quadrilateral, flattened, and concave *anteriorly*, for the insertion of the pronator quadratus muscle; convex and irregular *posteriorly*, and marked with *three grooves*, an *external*, *middle*, and *internal:* of these, the middle is the deepest and narrowest, is directed downwards and outwards, and lodges the extensor secundi internodii pollicis tendon. The *internal* is wider, and gives lodgement to the tendons of the extensor communis and indicator muscles. The *external* is the widest, but shallowest of the three, is sometimes divided into two, and gives passage to the tendons of the extensor carpi radialis longus and brevis muscles; on its external surface it presents a triangular rough surface, for the insertion of the supinator longus tendon, and terminates inferiorly in the *styloid process*, to which is attached the external lateral ligament of the wrist-joint: this is sometimes grooved posteriorly for the passage of the tendons of the extensor ossis metacarpi pollicis and primi internodii. *Internally*, is a smooth articulating surface, concave, which receives the outer edge of the ulna. *Inferiorly*, the radius presents a concave articular surface, somewhat triangular, the base internally, divided into two surfaces, an external and an internal, by a ridge running from before backwards: of these the external surface is large and triangular, and connected to the scaphoid bone; the internal is quadrilateral, and articulates with the os lunare. The ridge is received between these bones; into its inner edge is implanted the *triangular cartilage* of the wrist-joint, which here separates this articular surface from that for the ulna; the anterior and posterior edges of these surfaces give attachment to the anterior and posterior carpal ligaments.

The radius belongs to the class of long bones; it is developed from three points of ossification—one for each extremity, and one for the body; it articulates with four bones, the humerus, the ulna, the scaphoid, and lunar bones.

Muscles attached to the Radius:

To tubercle	*Biceps.*
anterior surface	*Flexor digitorum sublimis.* .... *longus pollicis.* *Supinator brevis.* *Pronator quadratus.*
outer border	*Pronator teres.*
near styloid process	*Supinator longus.*
posterior surface	*Extensor ossis metacarpi pollicis.* ....*primi internodii* ....

The *Ulna* is situated in the internal and posterior part of the fore-arm, large and irregular above; it gradually diminishes as it passes downwards; is triangular in the centre, exceedingly small, and circular inferiorly; it is longer than the radius, and passes much higher up on the arm. It may be divided into a *superior* and *inferior extremity*, and a *body* or *shaft*.

The *superior extremity* is the large irregular portion which articulates with the humerus; on it are two large processes, a posterior and an anterior: the posterior, called the *olecranon*, ascends almost directly upwards from the shaft of the bone, being the highest part of the ulna; superiorly, it gives insertion to the triceps muscle; posteriorly, it is marked by a smooth, elongated, triangular surface, subcutaneous, and covered by a bursa mucosa; internally, it gives attachment to the internal lateral ligament of the elbow-joint, and the flexor carpi ulnaris muscle; anteriorly, it is covered by cartilage, and forms part of the *great sigmoid cavity*.

The *anterior* or *coronoid* process projects from the anterior surface of the bone; it is pointed and triangular, and turned a little upwards: it gives insertion to the brachialis anticus muscle inferiorly; superiorly, it is concave, and covered with cartilage; internally, it projects, and gives attachment to the internal lateral ligament, and the pronator teres and flexor sublimis muscles; externally, it is marked with a concave articular surface, elongated from before backwards, termed the *lesser sigmoid cavity* of the ulna, which receives the lip or edge on the upper extremity of the radius; in front of and behind this surface is attached the orbicular ligament of the radius. The olecranon and coronoid processes are connected anteriorly by a smooth articular surface, named the *great sigmoid cavity*, concave from above downwards, convex from side to side, partially divided by a transverse depression into two surfaces, of which the upper vertical portion is the larger. It is also divided from above downwards by a vertical ridge into two lateral surfaces, nearly equal in size, the internal being in general somewhat larger: this part articulates with the trochlea of the humerus, and is continuous with the *lesser sigmoid cavity*.

The *body* or *shaft* of the ulna is triangular, and presents three surfaces and three edges. The *anterior* surface, concave, is marked towards its upper part by the foramen for the nutritious artery, which is directed upwards; its *posterior* surface, irregular, is divided by a line, which commences at the lesser sigmoid cavity, and descends, first obliquely, then vertically, into two surfaces, an internal and external; the *internal* surface flattened, and slightly concave above, rounded and convex below, is inferiorly subcutaneous. Of the *three edges*, the *external* or *radial*, sharp and projecting above, rounded below, gives attachment to the interosseous membrane; the *anterior*, rounded; the posterior is subcutaneous, projects much, and gives insertion to the tendinous aponeurosis of the fore-arm.

The *inferior extremity* of the ulna, unlike that of the radius, is much smaller than the superior; it expands a little, and is marked by two articular surfaces, an external and an inferior; the external is convex, long from before backwards, and articulates with the radius; the inferior is somewhat circular, nearly plane, and corresponds to the inter-articular cartilage of the wrist-joint; it is bounded internally by a depression, into which is implanted the apex of this cartilage; internally and posteriorly, the ulna terminates in a long-pointed and slightly-curved process, termed the *styloid process*, which gives attachment to the internal lateral ligament of the wrist-joint: on the posterior surface of this process is a deep groove, which transmits the tendon of the flexor carpi ulnaris, and externally, and near its root, is the depression already described for the apex of the inter-articular cartilage.

The structure of the ulna is the same as of all long bones; it is developed by five points of ossification, one each, for the upper and lower extremities, the body, the olecranon, and coronoid processes; it articulates with but two bones, the humerus above and the radius above and below.

Muscles attached to the Ulna:

To coronoid process . . .	*Brachialis anticus.*
	Pronator radii teres.
	Flexor digitorum sublimis.
	.... *longus pollicis.*

To anterior surface	*Flexor digitorum profundus.* .... *carpi radialis.* *Pronator radii quadratus.*
olecranon	*Triceps.*
posterior surface . . .	*Anconæus.* *Supinator radii brevis.* *Extensor carpi ulnaris.* .... *ossis metacarpi pollicis.* .... *primi internodii pollicis.* .... *secundi internodii pollicis.* .... *indicis.*

THE BONES OF THE HAND.

The bones of the hand consist of the *carpal*, *metacarpal*, and the phalanges.

The *carpal bones* are eight in number, and are divided into two rows, a superior and inferior, or carpal and metacarpal; each containing four bones: the superior row contains from without inwards the *os scaphoides* or *naviculare*, the *os lunare*, the *os cuneiforme* or *pyramidale*, and the *os pisiforme*; the inferior, the *os trapezium*, *os trapezoides*, *os magnum*, and *os unciforme*.

The *os scaphoides* is placed between the radius superiorly, the second row inferiorly, and the os lunare internally; it is the largest of this row, is curved and elongated downwards and outwards; it has three articular, and three non-articular surfaces; into the external surface is implanted the external lateral ligament of the wrist-joint; it articulates with five bones—the radius, the trapezium and trapezoides, the os lunare, and os magnum. No muscle is distinctly attached to it.

The *os lunare* lies between the scaphoid and the cuneiform-bone, the radius superiorly, and the second row inferiorly; it is irregular in shape, and has four articular and two non-articular surfaces: its external articular surface is concave and semilunar, whence its name, and articulates with the os scaphoides. It articulates with five bones, the radius, the os magnum and unciforme, the scaphoid, and the cuneiform bone. It has no muscle attached to it.

The *os cuneiforme* or *pyramidale* is placed in the inner side of the carpus, between the ulna superiorly, the unciform bone inferiorly, and the os lunare externally, on a plane inferior to it; it has four articular and two non-articular surfaces: of the articular surfaces the superior, directed a little inwards, is convex, and corresponds to the triangular cartilage of the wrist-joint, which separates it from the ulna. It articulates with three bones; the os lunare, the os unciforme, and the os pisiforme, and the fibro-cartilage already mentioned. No muscle is attached to it.

The *os pisiforme* is the smallest of the carpal bones, and is situated on the anterior surface of the last described bone. It possesses but one articular surface, which is placed on its posterior part, and articulates with the cuneiform bone; anteriorly it gives attachment to the anterior annular ligament, and in the rest of its extent, to ligaments connecting it to the metacarpal bone of the fifth finger and unciform bone. It articulates with but one bone, the cuneiform.

Muscles attached to the Pisiform Bone:

Flexor carpi ulnaris.
Abductor minimi digiti.

The *os trapezium* is placed between the scaphoid above, the first and second metacarpal bones below, and the trapezoides internally. It has three articular and three non-articular surfaces; the external non-articular surface gives attachment to the external lateral ligament of the wrist-joint; the anterior surface is marked by a deep groove directed forwards and outwards, which gives passage to the tendon of the flexor carpi radialis, and into the edge of which is implanted the anterior annular ligament. It articulates with four bones, the scaphoid, the first metacarpal bone, the second metacarpal bone, and the trapezoides.

Muscles attached to the Os Trapezium:

Extensor ossis metacarpi pollicis.
Abductor pollicis.
Opponens ....
Flexor brevis ......
Abductor indicis.

The *os trapezoides* is the smallest bone of the second row, and is placed between the scaphoid, the os trapezium, the os magnum, and the second metacarpal bone; it is somewhat of a wedge shape, expanded towards the dorsum, contracted towards the palm of the hand; it has four articular and two non-articular surfaces. It articulates with four bones: the scaphoid, the second metacarpal bone, the os magnum, and the trapezium.

Muscle attached to the Trapezoid Bone:

Flexor brevis pollicis.

The *os magnum* is the largest of the carpal bones; four of its surfaces are articular, two non-articular; the superior articular surface, called its head, is convex, and is received into a cavity formed by the scaphoid and lunar bones; it is supported by a contracted part of the bone, termed the neck. The os magnum articulates with seven bones, the scaphoid, lunar, the second, third, and fourth metacarpal bones, the trapezoides, and the unciform.

Muscle attached to Os Magnum:

Flexor pollicis brevis.

The *os unciforme* is the second largest bone of the carpus, and occupies its inferior internal part; it is easily recognized by its hook-like process, whence it has received its name; it has three articular surfaces, two non-articular. The hook-like process, turned forwards and outwards, concave externally, convex internally, gives attachment to the anterior annular ligament of the carpus, and some of the muscles of the little finger. The unciform bone articulates with five bones; the lunar, the os magnum, the cuneiform, and the fourth and fifth metacarpal bones.

Muscles attached to the Unciform Bone:

Flexor brevis minimi digiti.
Adductor minimi digiti.

The *bones* of the carpus belong to the class *irregular bones;* their structure therefore is spongy, covered with a thin layer of compact tissue; hence their great liability to caries; they are developed from a single point of ossification, with the exception of the unciform, which possesses two; the os pisiforme is not ossified till approaching puberty; it might be described as a sesamoid bone, being developed in the tendon of the flexor carpi ulnaris, as the patella is in the tendon of the rectus.

The *metacarpal bones* are five in number; they belong to the class of long bones, and may be divided each into a superior or carpal extremity, a body or shaft, and an inferior or phalangeal extremity.

The *first metacarpal bone* is the shortest and strongest; its phalangeal extremity or head is convex, quadrilateral, and marked with an articular surface, extending towards the side of the flexion, for junction with the first phalanx; anteriorly are two depressions, which correspond with the two sesamoid bones; and laterally are rough surfaces for the attachment of ligaments; the articulating surface has been erroneously described as triangular or wedge-shaped, in order to account for the difficulty experienced in reducing the dislocation of this articulation, termed Hey's Dislocation of the Thumb.

The *second metacarpal bone* is the longest, and articulates with five bones, viz. trapezium, trapezoides, os magnum, second metacarpal bone, and first phalanx.

The *third metacarpal bone* is next in size and length to the preceding; it articulates with four bones, the os magnum, second and fourth metacarpal bones, and the first phalanx.

The *fourth metacarpal bone* is shorter than the preceding. It articulates with five bones, the os magnum and unciforme, the second and fifth metacarpal bones, and first phalanx.

The *fifth metacarpal bone* is smaller than the preceding. It articulates with three bones, the unciform, fourth metacarpal bone, and first phalanx.

The metacarpal bones belong to the class of long bones; they are developed by two points of ossification, one for the body, and one for the phalangeal extremity, with the exception of the first, in which a second point of ossification is formed for its carpal extremity. The metacarpal bones are supported by the carpal, as follows: the first by one, the trapezium; the second by three, the trapezium, trapezoides, and os magnum; the third by one, the os magnum; the fourth by two, the os magnum and unciform; the fifth by one, the unciform.

Muscles attached to the Metacarpal Bones:

To first metacarpal bone	*Abductor indicis.* *Extensor ossis metacarpi pollicis.* *Opponens pollicis.*
four metacarpal bones of the fingers	*Interossei externi et interni.*
second metacarpal bone	*Abductor indicis.* *Flexor carpi radialis.* *Extensor carpi radialis longior.*
third	*Adductor pollicis.* *Extensor carpi radialis brevior.*
fifth	*Extensor carpi ulnaris.* *Flexor* .... *Adductor minimi digiti.*

The *phalanges* are fourteen in number, three for the four inner fingers, and two for the thumb; they are named in their numerical order from above downwards, viz. the *first* or *metacarpal phalanx*, the *second* or *middle*, the *third* or *ungual phalanx*. The first phalanx of the third or middle finger is the longest, that of the little finger the shortest and smallest. The *second* or *middle phalanx* is the next in size and length: the thumb wants this phalanx.

The *third* or *ungual phalanges* are five in number; inferiorly become thin and pointed, and terminate by a rough eminence, which gives insertion anteriorly to the tendons of the flexor profundus, posteriorly supports the nails: the largest is that of the thumb; the smallest that of the little finger.

The first and second phalanges may be classed amongst the long bones, as they present all their characters; the third belong to the irregular bones, and are, like these, spongy in their structure; they are developed from two points of ossification, one for the centre, and one for the superior extremity. Connected with the under surface of the head of the first metacarpal bone of the thumb are two sesamoid bones; these, like those of the foot, are to give attachment to muscles, and to obviate the effects of friction.

Muscles attached to the Phalanges:

First phalanx of thumb and sesamoid bones	*Extensor primi internodii pollicis.* *Abductor pollicis.* *Adductor* .... *Flexor brevis* ......
Second phalanx of thumb	*Extensor secundi internodii pollicis.* *Flexor longus pollicis.*
To first phalanx of the four fingers	*Interossei.* *Lumbricales.* *Extensor communis digitorum.*
To first phalanx of index finger	*Extensor indicis.* *Abductor* ....
To first phalanx of little finger	*Flexor brevis minimi digiti.* *Abductor* ....
Second phalanx of the four fingers	*Flexor digitorum sublimis.* *Extensor communis digitorum.*
Third phalanx of the four fingers	*Flexor digitorum profundus.* *Extensor digitorum communis.*

THE ARTICULATIONS OF THE UPPER EXTREMITY.

The articulations of the upper extremity are the *sterno-clavicular* articulation, the *scapulo-clavicular*, the *scapulo-humeral* or *shoulder-joint*, the *elbow-joint*, the *superior* and *inferior radio-ulnar articulations*, the *wrist-joint*, and the *carpal*, *metacarpal*, and *phalangeal* articulations.

THE STERNO-CLAVICULAR ARTICULATION.

The *sterno-clavicular articulation* is formed between the sternum and clavicle; for this purpose the *sternum* presents on its upper surface, and near its external and posterior part an articular surface, directed backwards and outwards, which receives the sternal end of the clavicle: both these surfaces are incrusted with cartilage, and are connected by the *anterior* and *posterior sterno-clavicular*, and the *inter-clavicular* ligaments, an *inter-articular cartilage*, and a *synovial membrane.*

The *anterior* ligament arises from the anterior surface of the sternal extremity of the clavicle, passes downwards and inwards, and is attached to the anterior surface of the sternum, where it is lost in the aponeurosis covering this bone.

The *posterior sterno-clavicular* ligament arises from the posterior part of the sternal extremity of the clavicle, descends inwards, and is inserted into the posterior surface of the sternum.

The *inter-clavicular ligament* has no immediate connexion with the joint; it is placed behind, and a little above the upper extremity of the sternum, and stretches transversely from the sternal extremity of one clavicle to that of the other; it is exceedingly variable as to size and form; its upper edge gives attachment to the cervical fascia. Its principal use is to connect the clavicles together.

On cutting into the sterno-clavicular articulation we see the inter-articular cartilage; it is a somewhat circular plate of fibro-cartilage, placed between the clavicle and sternum. Like all inter-articular cartilages, it is thick in the circumference, is thin and sometimes perforated in the centre; superiorly, it is attached to the sternal end of the clavicle; inferiorly and internally, it is thin and continuous with the cartilage of the first rib; anteriorly and posteriorly, it has attached to it the anterior and posterior sterno-clavicular ligaments; this cartilage, when perfect, separates the *synovial membrane* of the articulation into two sacs, an internal and external; when imperfect, as it is sometimes in the centre, the two synovial sacs become continuous. The synovial membrane also lines the inner surface of the ligaments immediately connected with the joint. This articulation belongs to the class *Arthrosis.*

As we pass outwards, we find that the clavicle is connected by ligaments to the first rib and the coracoid process of the scapula, without forming any articulation; the first of these we meet with is the *costo-coracoid* ligament: it is called also the *costo-clavicular* ligament, or the *ligamentum bicorne;* it is exceedingly variable as to size, shape, and thickness. It is attached internally by means of a strong well-marked band of fibres to the cartilage, upper edge, and outer surface, of the body of the first rib; some of its fibres pass inwards, but the greater number are directed upwards and outwards, and are implanted into the under surface of the clavicle, dividing as it passes outwards into two layers, which inclose the subclavius muscle, and finally are inserted into the coracoid process of the scapula: the layer which covers the anterior surface of the muscle is much better marked than that covering the posterior surface. Internally and externally, this ligament is in general well defined, but becomes thin and aponeurotic in the centre; its inferior edge is free, lunated, directed backwards, and corresponds with the axillary vein; its internal extremity is sometimes described as a distinct ligament, under the name of *rhomboid.* It is this ligament which renders it difficult to compress the artery immediately below the clavicle.

External to this ligament, and near its outer extremity, we meet with the ligaments connecting the clavicle to the coracoid process of the scapula; these are named *conoid* and *trapezoid.*

The *conoid* is of a conical shape; its base, turned upwards, is attached to a tubercle on the under surface of the clavicle; its apex, directed downwards, is inserted into the posterior expanded portion of the coracoid process; it is placed internal and posterior to the other, and descends nearly vertically.

The *trapezoid* ligament is of a quadrilateral shape, attached superiorly to an oblique line on the under surface of the clavicle, passes obliquely downwards, forwards, and inwards, and is inserted into the upper surface of the coracoid process near its base. Anteriorly, these ligaments are separated by a triangular interval, filled with cellular substance, and the insertion of the subclavius muscle; they assist in preventing displacement of the clavicle upwards, support the scapula, and prevent the neck of this bone from falling downwards when fractured.

THE SCAPULO-CLAVICULAR ARTICULATION.

This articulation is formed between the external end of the clavicle and the inner edge of the acromion process; they are held together by the *superior* and *inferior* ligaments, which consist of a number of fibres passing from one bone to another. The articulation is lined internally by a synovial membrane, and is occasionally provided with an *interarticular cartilage;* it belongs to the class *Planiform.*

LIGAMENTS OF THE SCAPULA.

The scapula has two ligaments attached to it, called the *superior* and *posterior.*

The *superior proper ligament*, also called the *deltoid*, *triangular*, or *coraco-acromial ligament*, stretches between the coracoid and acromion processes, above and a little internal to the shoulder-joint. It is of a triangular shape, with its base attached anteriorly to the coracoid process; from this it passes upwards, backwards, and outwards, and is inserted by its apex into the acromion process; its under surface corresponds with the head of the humerus with the intervention of a large bursa mucosa.

The *posterior proper*, or *coracoid ligament*, is situated immediately behind the root of the coracoid process, from the base of which it passes backwards over the notch in the superior costa of the scapula, and is inserted into the opposite edge of the notch: it converts this notch into a foramen, which is traversed by the supra-scapular nerve, whilst the artery of the same name passes in general above it; it gives origin to the omohyoid muscle, and is frequently converted into bone.

THE SCAPULO-HUMERAL ARTICULATION, OR SHOULDER-JOINT.

This articulation is formed by two bones, the *scapula* and *humerus*. The *scapula* presents for this purpose the *glenoid cavity*, which is superficial, but is considerably deepened in the recent state by the cotyloid or glenoid ligament surrounding it, and by the cartilage, which is for this purpose thick at the circumference, thin in the centre. The part of the humerus which forms this articulation is the head; this is a round hemispherical convex eminence, much larger than the glenoid cavity.

THE LIGAMENTS OF THE SHOULDER-JOINT.

The ligaments are the *capsular*, the *coraco-humeral* or *accessory*, and the *cotyloid* ligament, lined by synovial membrane.

The *capsular ligament* is attached superiorly around the anatomical neck of the scapula, beyond the cotyloid ligament; from this it passes downwards, forwards, and outwards, and is inserted inferiorly into the anatomical neck of the humerus descending below the tuberosities to which it is attached; it is much larger here than at the scapula, and hence is of a conical shape, the apex towards the scapula, the base at the humerus. This ligament is exceedingly thin anteriorly and posteriorly, but is strong towards its upper and inner part, where it is strengthened by the accessory or coraco-humeral ligament, and inferiorly towards the axilla; externally it is closely connected to the several muscles surrounding the articulation; it is perforated by the long tendon of the biceps anteriorly, the sub-scapular tendon internally, and sometimes by the supra-spinatus tendon superiorly; its internal surface is lined by the synovial membrane. In order to allow of the great mobility of the articulation, it does not connect the bones closely together, but allows of their separation to the extent of at least an inch; this occurs occasionally even in the living subject, as in paralysis of the deltoid muscle; and, no doubt, favours dislocation.

The *coraco-humeral* or *accessory ligament* is situated at the upper and inner part of the articulation; it is attached superiorly to the outer edge and under surface of the coracoid process, directs itself downwards and outwards, and is implanted into the anterior part of the greater tuberosity of the humerus; this ligament is almost identified with the capsular ligament, and appears sometimes merely as a few irregular fibres appended to it.

The *cotyloid* or *glenoid ligament* is placed around the brim of the glenoid cavity, to which it intimately adheres, superiorly continuous with the long head of the biceps, by the splitting of which it is said to be formed, or, according to some anatomists, forms this tendon; it is triangular, the base attached, the apex free; it is deeper posteriorly than anteriorly; its structure is fibro-cartilaginous, the fibres running obliquely towards the bone; its use is to deepen the glenoid cavity so as to prevent dislocation, and to give origin to the tendon of the biceps.

The *synovial membrane* of this articulation is extensive, and rendered complicated by the passage of the tendon of the biceps, which passes through the articulation, though external to this membrane which invests it. It lines the capsular and cotyloid ligaments, covers the head of the humerus, lines the inner surface of the tendon of the subscapularis and supra-spinatus; sometimes that of the infra-spinatus. As it passes to the neck of the humerus it forms folds, named *retinacula*. The upper part of this articulation is covered by a bursa which intervenes between it, the coracoid and acromion processes, and the coraco-acromial ligament; it contains much synovia, and obviates the effects of friction from the head of the bone pressing against these structures.

The shoulder-joint belongs to the class Arthrosis. It is the most moveable articulation in the body, enjoying *flexion*, *extension*, *abduction*, *adduction*, *rotation*, and *circumduction*. This articulation is exceedingly liable to dislocation, which results from the superficial excavation of the glenoid cavity, and its small size in comparison of the head of the bone, the lax and weak state of the capsular ligament, and the extensive motions it enjoys: were it not, in fact, for the assistance which the surrounding tendons, bones, &c. give to the articulation, and the great mobility of the scapula which follows the head of the bone like a faithful friend, dislocation would be almost inevitable on the slightest exertion.

THE HUMERO-CUBITAL ARTICULATION, OR ELBOW-JOINT.

This articulation is formed by three bones; the *humerus*, the *ulna*, and the *radius*. The parts of the humerus entering into it are named the capitulum, trochlea, and epitrochlea. The ulna presents the great and less sigmoid cavities, and the radius its head.

THE LIGAMENTS OF THE ELBOW-JOINT.

The ligaments of the elbow-joint are the *anterior* and *posterior* ligaments; the *internal* and *external lateral* ligaments, lined by synovial membrane.

The *anterior ligament* is a thin weak ligament, composed of fibres loosely connected together; it commences superiorly from the surface of the lower extremity of the humerus, above the internal condyle and the anterior humeral fossa; from this its fibres descend, to be attached to the orbicular ligament of the radius; when well marked a few fibres may be traced to the coronoid process of the ulna. Its anterior surface is covered by the brachialis anticus muscle, to which it is connected, but not intimately, by cellular substance.

The *posterior ligament* may be exposed by detaching from it the tendon of the triceps muscle; this must be done with care, as the ligament is exceedingly thin, and adheres intimately to the muscle; it is not so well marked as the preceding. It arises superiorly from the posterior surface of the humerus, around the posterior humeral fossa, passes downwards, and is inserted into the summit of the olecranon process. Its fibres are badly marked, but may be divided into two portions, a descending, situated on the internal part of the joint, and a transverse, which is the more distinct, and crosses between the condyles of the humerus.

The *external lateral ligament* is intimately connected with the tendinous origins of the supinator and extensor muscles, particularly that of the supinator brevis; superiorly it is attached to the external condyle of the humerus, passes downwards, expands, and is inserted inferiorly into the orbicular or annular ligament of the radius, having no connexion with the bone.

The *internal lateral ligament* is perfectly distinct, and lies under the origin of the flexor carpi ulnaris muscle. Superiorly it is attached to the internal condyle of the humerus: from this its fibres descend in a radiated manner, and divide into two fasciculi, of which one is anterior, the other posterior: the anterior fasciculus passes downwards and a little backwards, and is implanted into the inner surface of the coronoid process of the ulna; the posterior passes almost directly backwards, and inserts itself into the side of the olecranon. On cutting into the articulation, it will be found lined by synovial membrane, which is reflected upon the ligaments just described, and also covers the neck and cup-like cavity of the radius, and then lines the orbicular ligament.

The elbow-joint is a perfect *Angular Ginglymus*; its motions, therefore, are confined to flexion and extension.

THE RADIO-ULNAR ARTICULATIONS.

These are two in number: the *superior* and *inferior.*

The *superior radio-ulnar articulation* is formed between the lesser sigmoid cavity of the ulna and the lip of the radius; one ligament alone exists here, named the *orbicular* or *annular* ligament. This is a strong resisting ligament, anteriorly attached to the edge of the lesser sigmoid cavity of the ulna; it surrounds two thirds of the head of the radius, passing also to a short extent on its neck, and is implanted posteriorly into the posterior edge of the lesser sigmoid cavity: this ligament is of a strong fibrous, or, in some instances, of a fibro-cartilaginous nature; it has inserted into it the external lateral ligament, and the anterior ligament of the joint; externally it is covered by the supinator brevis muscle; internally it is lined by the synovial membrane, which is continuous with that of the elbow-joint. This articulation belongs to the class *Lateral Ginglymus;* its motions are rotatory.

Besides the ligaments just enumerated as being connected with these articulations, we have the *anterior oblique ligament,* which cannot be closed with any particular joint.

The *anterior oblique ligament* is attached superiorly and internally to the coronoid process of the ulna, below the insertion of the brachialis anticus muscle, descends obliquely outwards, lying internal to the biceps tendon, and is implanted inferiorly and externally into the radius immediately below its tubercle, and separates the supinator brevis and flexor sublimis muscle: it is quite distinct from the interosseous membrane; its principal use is to prevent too great supination of the fore-arm: in pronation it is relaxed.

The radius and ulna are united in the centre of the fore-arm by a strong fibrous structure, termed the *interosseous membrane* or *ligament,* attached externally to the inner edge of the radius; it descends obliquely from this, and is implanted into the opposite edge of the ulna; it is deficient above to a considerable extent, to give room for the origins of some of the flexor and extensor muscles, the insertion of the biceps tendon, and the transmission of the posterior interosseous artery, and also below for the passage of one of the terminating branches of the interosseous artery; in its centre it presents numerous foramina for the passage of vessels and nerves; its anterior surface is covered by the flexor profundus, flexor longus pollicis, and pronator quadratus muscles, and the interosseous artery and nerve; its posterior surface is covered by the supinator brevis, extensores pollicis and indicator: besides giving origin to these muscles, it serves to connect the radius and ulna.

The *inferior radio-ulnar articulation* is formed between the lower extremities of the radius and ulna, where they are in contact: for this purpose the *ulna* presents a round convex surface, oblong, incrusted with cartilage, which is received into a corresponding concave surface on the radius, an arrangement precisely the reverse of that on the superior extremities of the bones.

One ligament only, lined by synovial membrane, belongs to this articulation, the *sacciform ligament*; this envelops the articular surface on the ulna, to the edges of which, as well as to those of the articular surface of the radius, it is attached; it is exceedingly thin, lax, and weak, and is lined internally by a synovial membrane, which contains much synovia; a triangular fibro-cartilage is connected with this articulation, but more properly belongs to the wrist-joint. This articulation belongs to the class of *Lateral Ginglymus.*

THE RADIO-CARPAL ARTICULATION, OR WRIST-JOINT.

This articulation is formed by three bones, the inferior extremity of the *radius*, and two of the first row of carpal bones, viz., the *os scaphoides* and the *os lunare.* The *os cuneiforme* does not enter into this articulation, as it corresponds with the inter-articular fibro-cartilage, which separates it from the ulna.

THE LIGAMENTS OF THE WRIST-JOINT.

The ligaments of the wrist-joint are, the *external* and *internal lateral*, the *anterior* and *posterior ligaments*, lined by synovial membrane.

The *external lateral ligament* is attached to the point of the styloid process of the radius; from this its fibres descend, diverging, and are implanted inferiorly into the outer surface of the os scaphoides, the os trapezium, and the anterior annular ligament: its external surface corresponds to the radial artery which winds round it.

The *internal lateral ligament*, not so well marked as the preceding, is attached to the point of the styloid process of the ulna, descends forwards, and is implanted into the os cuneiforme and the os pisiforme, some of its fibres passing to the anterior annular ligament.

The *anterior ligament* is an irregular set of fibres, which descend from the lower extremity and anterior surface of the radius, to be attached into the anterior surface of the os scaphoides, os lunare, and os cuneiforme.

The *posterior ligament*, not so strong as the preceding, is attached like it to the lower extremity of the radius on its posterior surface; from this it descends, and is inserted into the posterior surface of the os lunare and os cuneiforme.

On cutting into the articulation it will be found to contain in its interior an inter-articular fibro-cartilage, which intervenes between the ulna and os cuneiforme. It is triangular in shape; its apex is attached internally into the depression at the root of the styloid process of the ulna; it passes transversely outwards, and is implanted by its base into the ridge which separates the ulnar from the carpal articulating surface on the radius. Its surfaces are concave, are lined by synovial membrane, and correspond to the ulna above, the os cuneiforme beneath; its edges are connected to the ligamentary fibres of the articulation. Occasionally it is perforated in its centre, and then the lower extremity of the ulna comes in contact with the os cuneiforme: and thus these bones may be said to assist in forming the wrist-joint.

The *synovial* membrane, lining the articulation, covers the extremity of the radius, the under surface of the fibro-cartilage, is reflected from these on the ligaments, and passes thence to line the upper surface of the first row of carpal bones.

Connected with this articulation, but not exactly belonging to it, are the *anterior* and *posterior annular ligaments* of the wrist; these are two strong fibrous membranes, situated on the anterior and posterior part of the wrist, and surrounding it like a wring or annulus.

The *anterior annular ligament* is placed in front of the carpal bones; externally, it is attached to the anterior surface of the os trapezium and os scaphoides, passes transversely inwards, and is attached internally to the hook-like process of the unciform bone, and sends a process to be attached to the os pisiforme: between these two portions the ulnar artery and nerve pass. The anterior surface of this ligament is covered by the integuments, and is crossed by the superficialis volæ artery, and in the centre by a small branch of the median nerve; it gives origin externally to the abductor, opponens, and flexor brevis pollicis muscles, internally to the palmaris brevis. Its posterior surface is arched, and has passing beneath it the tendons of the flexor carpi radialis, flexor profundus, flexor sublimis, and flexor longus pollicis muscles, the median nerve, and the termination of the interosseous artery entering the palm of the hand: it is here lined by a synovial sheath, which envelops these tendons. Into its superior edge is implanted the tendon of the palmaris longus muscle; from its inferior edge arises the palmar aponeurosis: its use is to form an arch for the passage of the above-mentioned parts, to protect them from injury, and to connect the carpal bones in the transverse direction, and thus prevent the arch which they form from being obliterated, and so as not to interfere with the action of the tendons.

The *posterior annular ligament* is not near so well marked, and appears to be merely a prolongation of the fascia of the fore-arm, forming sheaths for the extensor tendons; it is attached externally to the posterior surface of the radius, passes obliquely downwards and inwards, and is implanted into the posterior surface of the cuneiform and unciform bones, having little if any connexion with the ulna; by this means the hand is more intimately connected with the radius, and follows it in the motions of pronation and supination. The wrist-joint belongs to the class *Arthrosis;* its motions are *flexion*, *extension*, *abduction*, *adduction*, and *circumduction*.

THE ARTICULATIONS OF THE HAND.

The *articulating surfaces of the first row of carpal bones*, where they are opposed to one another, need not be minutely described; they are, in general, *arthrodial* or *planiform*, and are connected by *palmar*, *dorsal*, and *interosseous* ligaments; the palmar are the best marked; their cartilaginous surfaces are lined by synovial membranes.

The *os pisiforme* is held firmly in its place by several ligaments. Superiorly the internal lateral ligament of the wrist-joint is attached to it, as already described. Inferiorly, two ligaments stretch from it: one implanted into the hook-like process of the unciform bone; another, an exceedingly strong ligament, and apparently the continuation of the tendon of the flexor carpi ulnaris, descends from it inwards, to be inserted into the base of the fifth metacarpal bone. A portion of the annular ligament is attached to it, and its articular surface is surrounded by a capsular ligament, lined by synovial membrane.

The *articulations between the first and second rows of carpal bones* are remarkable. In the centre, an *enarthrodial* articulation is formed by the head of the os magnum being received into the cavity formed by the os lunare and os scaphoides; on either side of this an *arthrodial* articulation is formed: these articulations are connected in front and behind by palmar and dorsal ligaments, laterally by expansions from the lateral ligaments of the wrist-joint.

The *articulations between the carpal bones forming the second row* are connected, in like manner, by dorsal and palmar ligaments, stretching from one bone to the other. It may be perceived that several of these ligaments stretch from the anterior surface of the os magnum to the surrounding bones: these are to keep it firmly in its situation; for although apparently the most secure bone of the carpus, it is most liable to dislocation, its head being thrown backwards towards the dorsum of the hand—this is caused by the bone being so impacted between the others as to bear a considerable portion of any violence applied to this; and from its wedge-shape, and the apex being turned towards the palm of the hand, force applied in any direction, except directly on its base, will have a tendency to dislocate it backwards.

The *carpo-metacarpal articulations* are formed between the second row of carpal bones and the metacarpus; they are connected by dorsal and palmar ligaments, stretching from the carpal to the metacarpal bones: of these, the dorsal are the more distinct. All these articular surfaces are lined by one synovial membrane, which is continuous throughout, with the exception of that belonging to the os pisiforme, which is distinct from the rest.

The *articulation between the os trapezium and the first metacarpal bone* belongs to the class *Arthrosis*, and possesses considerable motion, in order that the thumb may be enabled to oppose itself to the other fingers; its motions are *flexion*, *extension*, *lateral motion*, and *circumduction;* its chief security is the great strength of the muscles of the thumb.

The *metacarpo-phalangeal articulations* are formed by the round convex head of each metacarpal bone being received into the concavity of the first phalanx; they are connected by lateral ligaments on either side, and a strong ligament in front, which intermingles its fibres with the sheaths of the flexor tendons, and are lined internally by synovial membrane. The most remarkable of these articulations is that between the metacarpal bone of the thumb and the corresponding phalanx, as it is the subject of the dislocation which has received the name of Hey's Dislocation of the Thumb. They belong to the class *Arthrosis*, and possess every motion, with the exception perhaps of rotation.

The *inter-phalangeal articulations* are formed by the phalanges; the inferior extremity of each of these is concave from side to side, convex from before backwards: the superior extremity the reverse. They are connected by lateral ligaments and an anterior ligament, resembling that of the preceding, lined by synovial membrane; they belong to the class of *Angular Ginglymus*, and only admit of flexion and extension.

BONES OF THE HEAD.

The bones of the head may be divided into those of the cranium and those of the face, including the three common to both. The bones of the cranium are the *frontal*, two *parietal*, two *temporal*, *occipital*, *ethmoid*, and *sphenoid.*

The bones of the face are, two *malar*, two *superior maxillary*, two *nasal*, two *lacrymal*, two *inferior turbinated*, two *palatine*, the *vomer*, and *inferior maxillary.* The bones which may be called common to the head and face are the *frontal*, *ethmoid*, and *sphenoid.*

Along the edges of the occipital bone there are some small bones, irregularly developed in some skulls, named *ossa wormiana*, or *triquetra.*

The *Frontal* bone in shape resembles a cockle-shell, is convex anteriorly, concave posteriorly, forming the forehead, part of the base of the skull, the upper portion of the orbit and nose, and part of the temples. A suture sometimes extends down its centre, separating it into two bones. *Anteriorly*, on each side, we observe the frontal eminence, indicating the point of ossification; in the centre, the nasal prominence; and, a little behind that, the nasal spine; on each side, more laterally, the superciliary ridge; the external and internal angular processes; the supra-orbital notch or foramen; and a small foramen leading to the frontal sinus. *Laterally* we see the temporal process and part of the temporal fossa.

The *posterior* surface, uneven, presents a ridge for the attachment of the falx major, commencing at a point where the frontal and ethmoid bones form conjointly the foramen cæcum. The *orbito-nasal* surface presents the openings of the frontal sinuses; and laterally two grooves, which, by meeting the ethmoid bone, form the foramen orbitale internum anterius and posterius.

The *processes* are nine, viz.

nasal,
four angular,
two temporal,
two orbital.

The *foramina* are seven, five common and two proper. The common foramina are the

foramen cæcum,
two anterior internal orbital,
two posterior ....

The two proper are the

supraorbital.

This bone also assists in forming the foramen lacerum orbitale, named, more properly by Dr. Quain, sphenoidal fissure. The frontal bone articulates with twelve bones, viz. two parietal, ethmoid, sphenoid, two nasal, two lacrymal, two superior maxillary, and two malar.

The layers of this bone are hollowed out and separated anteriorly, forming the frontal sinuses, which open into the middle meatus of the nose; these sinuses do not exist in very young subjects. The outer layer is sometimes fractured and depressed without any alarming symptoms or consequences; but air may find its way into the cellular tissue, producing a form of emphyema.

The muscles attached to it on each side are

corrugator supercilii,
orbicularis palpebrarum,
temporalis,
occipito-frontalis, very slightly.

The *Parietal bone* of each side is quadrangular, convex externally, concave internally. The angles are four, viz. *anterior-superior, anterior-inferior, superior-posterior, inferior-posterior;* its edges are named *coronal, sagittal, lamboidal,* and *squamous.*

Externally there is a prominence about the centre, showing its single point of ossification; a temporal ridge forming part of the origin of the temporal muscle; and a parietal foramen, for the transmission of a vein to the superior longitudinal sinus.

Its *internal* surface presents a groove along the sagittal margin, for the superior longitudinal sinus; a ridge for the falx; little pits for the Pacchionian glands; arborescent grooves for the middle meningeal artery, which commences at the anterior-inferior angle, sometimes forming a foramen; a depression near the posterior-inferior angle for the lateral sinus; and eminences and depressions corresponding with the convolutions of the brain.

Each parietal is articulated with five bones, viz. the frontal, temporal, sphenoid, occipital, and with its fellow.

Muscle attached,

Temporalis.

The *Occipital bone* is diamond-shaped, and consists of a broad superior portion, two condyles, and the basilar portion or process.

The external-posterior surface, convex, presents, the occipital protuberance, which gives attachment to the ligamentum nuchæ, the perpendicular spine, the superior and inferior transverse ridges, and, lower down, the occipital foramen; and on each side of this the condyles, presenting ridges and inequalities laterally, in front, and behind, for the attachment of ligaments and muscles. Just behind the condyles are the posterior condyloid foramina, and in front the anterior condyloid foramina.

The basilar process connects the occipital with the sphenoid bone.

The *internal* surface of this bone presents the crucial spine with depressions for the superior longitudinal, occipital, and lateral sinuses, with ridges of attachment for the falx major and minor, and tentorium; above the transverse ridge depressions for the cerebrum, below it for the cerebellum, jugular notches, where this bone, with the temporal of each side, forms the jugular foramen, or foramen lacerum basis cranii posterius; a basilar sinuosity for the pons varolii, and lateral grooves for the inferior petrosal sinuses.

This bone is articulated with six others, viz. two parietal bones, two temporal, sphenoid, and with the first vertebra by ginglimoid articulation.

The Muscles attached to this bone are, to the superior ridge,

trapezius,
occipito-frontalis,
sterno-mastoideus.

To the space between the curved lines,

complexus,
splenius capitis.

To the space between the inferior transverse ridge and foramen magnum,

recti majores and *minores*,
obliquus capitis superior.

To below the jugal eminence,

recti laterales.

To the fossa, anterior to foramen magnum,

recti antici majores and *minores*,
superior and *middle constrictor pharyngis*.

The foramen magnum gives passage to the medulla oblongata, spinal arteries, vertebral arteries, and some veins and the nervus accessorius of each side. The posterior condyloid foramen (when present) transmits a vein into the lateral sinus, sometimes a small artery from the occipital; the anterior condyloid foramen transmits the hypoglossal or lingual nerve; the foramen jugulare gives passage to the lateral sinus, the nervus vagus, glosso-pharyngeus and accessorius, and a branch of the ascending pharyngeal artery.

The *Temporal bone* consists of three portions, the *petrous*, *squamous*, and *mastoid*. The processes are five, viz. *zygomatic*, *auditory*, *vaginal*, *styloid*, and *mastoid*.

The *squamous* portion presents for notice a thin semicircular edge; the zygomatic process; a tubercle; the glenoid cavity and glenoid fissure, and grooves internally for branches of the spinous artery.

The *petrous* portion presents externally an auditory process, vaginal and styloid process, the external auditory foramen; inferiorly the carotid foramen and canal, and jugular fossa; internally an auditory foramen, the aqueducts of the vestibule and cochlea, superior and inferior petrosal grooves, Eustachian canal, and hiatus fallopii.

The *mastoid process* presents the stylo-mastoid foramen, mastoid foramen, (sometimes in common with the occipital bone,) digastric fossa, occipital groove, and internally a lateral groove for the lateral sinus.

The temporal is connected with five other bones, viz. sphenoid, malar, parietal, occipital, and with the lower jaw by ginglymus.

The glenoid fissure transmits the chorda tympani, the tendon of the laxator tympani muscle, a small artery, and gives lodgement to the processus gracilis of the malleus.

The carotic foramen and canal transmit the internal carotid artery, and contain part of the carotid plexus of nerves.

The internal auditory foramen contains the portio mollis, portio dura, and an artery running between them.

The aqueducts of the cochlea and the vestibule transmit veins from those parts to the lateral sinus.

The petrosal grooves lodge the petrosal sinuses.

The hiatus fallopii admits the petrous branch of the vidian nerve.

In a groove adjoining the Eustachian canal, but separated from it by a thin osseous plate, named *processus cochleariformis*, is found the tensor tympani muscle.

The stylo-mastoid foramen transmits the portio dura, a small artery, and the chorda tympani nerve.

The mastoid foramen gives passage generally to a vein which enters the lateral sinus.

The Muscles attached to this bone are:

To the zygoma	*Masseter.*
squamous part . . .	*Temporalis.*
mastoid process . .	*Retrahens aurem.* *Sterno-mastoid.* *Splenius capitis.* *Trachelo mastoideus.*
digastric fossa . . .	*Digastricus.*
styloid process . .	*Stylo-glossus.* *Stylo-hyoideus.* *.......pharyngeus.*
petrous bone at its apex	*Levator palati.* *Tensor tympani.*

The *Sphenoid* bone consists of a body, great and small wings, and pterygoid processes.

The cerebral surface of the body presents the *ethmoid* process, the *olivary* process, and on each side the optic foramina; behind these the *sella turcica*, bounded by the anterior and posterior clinoid processes; on each side, lateral grooves for the carotid artery of each side: the posterior surface is rough, to join the basilar process of the occipital bone. The alæ minores extend laterally, partly support the anterior lobes of the brain: their posterior edge, corresponds with the fissure of Sylvius. The alæ majores have three surfaces, cerebral, orbital, and temporal; the cerebral forms part of the middle fossa of the cranium, and is marked by the convolutions of the brain and branches of the middle meningeal artery; in this part we notice the foramen rotundum, the foramen ovale, the foramen spinosum, and spinous process, and projecting inferiorly the styloid process.

Laterally is the temporal surface, forming part of the temporal fossa.

The parts seen on the under surface are the pterygoid plates or processes, external and internal, the inner one having the hamular process at its lower extremity; at the root of these is the vidian or pterygoid canal, and the fossa navicularis; between them the pterygoid fossa, and the rostrum or azygos process in the centre of the bone.

Anteriorly we observe the sphenoidal spongy bones and the openings of the sphenoidal sinuses, also the orbitar surface, forming the upper and back part of the orbit.

It is developed from seven points of ossification, which commence in the body, the lesser wings, the roots of the pterygoid process, and in the internal pterygoid process; in the fœtus it is divided into an anterior or spheno-orbital, and a posterior or spheno-temporal portion. The *processes* of the sphenoid are seventeen in number: one ethmoidal, one olivary, four clinoid, one azygos, two spinous, two styloid, four pterygoid, and two hamular: some anatomists enumerate a much greater number, considering the wings, &c. as processes. The *foramina* are twelve proper and four *common*: the proper are two optic, two round, two oval, two spinous, two vidian, and the two openings of the sinuses; the common are, two foramina lacera orbitalia, two foramina lacera anteriora in basi cranii. Besides these, the sphenoid bone forms part of the *spheno-maxillary fissure*, which is a cleft or fissure situated in the posterior and external part of the orbit, and is formed by the sphenoid, malar, superior maxillary, and palate bones.

The foramen rotundum transmits the second division of the fifth nerve.

The foramen ovale transmits the third portion of the fifth nerve and a small artery to the dura mater, named ramus meningeus parvus.

The foramen spinosum transmits the middle meningeal artery.

The sphenoidal fissure transmits

The motor oculi nerve,
trochlearis nerve,
first branch of the fifth nerve,
abducens nerve,
ophthalmic vein to the cavernous sinus.

The optic foramen gives passage to the optic nerve, and ophthalmic artery.

The vidian canal transmits the vidian nerve and artery.

The sphenoid articulates with twelve bones, viz. all those of the cranium, and five of the face, viz. the two malar, two palate bones, and the vomer.

The muscles attached are—

Around the foramen opticum of each side	*Levator palpebræ superioris.* *Obliquus superior.* *Four recti.*
To the external surface	*Temporalis.*
external pterygoid process	*External pterygoid.* *Internal pterygoid.*
internal pterygoid process	*Superior constrictor pharyngis.*
fossa navicularis	*Tensor palati.*
spinous process	*Laxator tympani.*

BONES OF THE FACE.

The *ossa nasi* are externally convex, internally concave; each presents a frontal, alar, nasal, and maxillary margin, internally the nasal spine, which connects it with the nasal lamella of the ethmoid bone, and frequently little foramina, for the transmission of small arteries and veins.

The Muscles attached are

pyramidalis nasi,
compressor nasi.

Each is articulated with four bones, viz. the frontal, superior maxillary ethmoid, and its fellow.

The *os maxillare superius* is an irregular-shaped bone; has a body and four surfaces, named *orbital*, *malar*, *nasal*, and *palatine*. The orbital surface presents the infra-orbital groove or canal, and a fossa for the inferior oblique muscle. The *malar* or *external* surface presents the nasal process, the lacrymal groove, the orbital ridge, the malar eminence, the malar process, the infra-orbital foramen; the myrtiform fossa, for the depressor labii inferioris alæque nasi; foramina, for the dental nerves and arteries; at the lower margin the alveolar process, and at the back part a groove, which forms part of the posterior palatine canal.

The *nasal* surface presents a long ridge, by which it is attached to the inferior spongy bone, a depression for the middle meatus of the nose, the opening of the lacrymal sac, and antrum highmorianum.

The *palatine* portion forms part of the floor of the nose, and roof of the mouth; on its inner margin is a ridge, which articulates with the vomer and nasal cartilage; in front the anterior nasal spine, the anterior palatine canal. The inferior surface is uneven and arched. Within the bone is the antrum highmorianum.

Each superior maxillary bone is articulated with nine others, viz. the frontal, ethmoid, os nasi, palate bone, malar, os unguis, vomer, inferior spongy bone, and its fellow.

The infra-orbitar foramen transmits the infra-orbitar nerve and artery.

The anterior palatine foramen transmits a nerve and an artery named accordingly.

The Muscles attached are,

Above the alveoli	*Buccinator.* *Levator labii superioris alæque nasi.*
To the canine fossa	*Compressor nasi.* *Levator anguli oris.*
edge of orbit	*Levator labii superioris.*
nasal process	*Orbicularis palpebrarum.*
In the orbit	*Obliquus inferior.*
To the tuberosity	*External pterygoid.*

The *os lacrymale* or *os unguis* has an external and internal surface; on the former is a ridge or spine, dividing it into the lacrymal groove and orbital surface. *Internally* it closes in the anterior ethmoidal cells, and forms part of the wall of the middle meatus of the nose. It is articulated with four bones, the frontal, superior maxillary, inferior spongy bone, and ethmoid. The only muscle attached to it is the

tensor tarsi.

The *Malar bone* has three surfaces, the malar, orbitar, and temporal. The *orbitar* surface presents a small foramen, named malar, which transmits the malar nerve.

The processes are five, viz. *maxillary*, *internal orbitar*, *superior orbitar*, *inferior orbitar*, and *zygomatic.* It is articulated with four bones, viz. the temporal bone, the os frontis, the sphenoid, and superior maxillary.

The Muscles attached are :

zygomaticus major,
.... minor,
masseter,
obliquus inferior.

Os Ethmoides. This bone is common to the head and face, and is of a cubical figure ; it may be divided into two lateral portions with the central nasal lamella ; the parts to be noticed are, the cribriform plate, with its foramina, the crista galli, the nasal plate, the anterior and posterior ethmoidal sinuses and cells, the turbinated plates, the orbitar plates, or ossa plana.

The foramina in this bone are *cribriform*, for the passage of the filaments of the first pair, the ethmoidal twig of the nasal, of the fifth, and some small arteries; in common with the frontal bone, the *ethmoid* forms the foramina orbitalia interna anteriora and posteriora.

The anterior orbital foramen of each orbit transmits a small artery, and the ethmoidal twig of the nasal nerve of the fifth: the posterior foramen only transmits a small artery.

The ethmoid is articulated with eleven bones, viz. the frontal, two lacrymal bones, two superior maxillary, two palate bones, two nasal bones, the sphenoid, and vomer: there are no muscles attached to it.

The *Palate bones* are situated at the posterior part and sides of the nares, posterior to the superior maxillary, and anterior to the pterygoid processes of the sphenoid; they enter into the formation of the roof of the mouth, the nose, and the orbits.

These bones consist of a palatine, nasal, pterygoid, orbitar, and sphenoidal processes.

The palatine process forms part of the floor of the nose and roof of the mouth; it presents internally an elevated ridge, and posteriorly the azygos or spinous process. On the nasal portion, forming part of the wall of the antrum, is a ridge for the attachment of the inferior turbinated bone.

The pterygoid process presents two grooves and a rough ridge, forming with the maxillary bone the palato-maxillary canal, and generally a small palatine foramen.

The orbitar process is small, forming the posterior part of the floor of the orbit.

The sphenoidal process unites with the body of the sphenoid: between the orbitar and sphenoid processes is the notch which forms part of the spheno-palatine hole.

The foramina are two; the palato-maxillary, or great palatine foramen, which transmits the great palatine nerve, and a corresponding artery; and the lesser palatine foramen, for a corresponding nerve and artery.

Each palate bone is connected with six other bones, viz. its fellow, the superior maxillary, the spongy bone, the sphenoid, ethmoid, and vomer.

The Muscles attached to it are

azygos uvulæ,
internal pterygoid,
aponeurosis of the tensor palati.

The *Vomer* is a flat bone, and forms part of the septum of the nose. It has no foramen or attachment of muscles. It is articulated above to the rostrum of the sphenoid; anteriorly to the ethmoid and nasal cartilage; below to the palate and superior maxillary bones; posteriorly its margin is free.

The *inferior Spongy bone*, likened to the half of a bivalve shell, is placed horizontally. It separates the middle from the inferior meatus of the nose, overlaps the opening from the nasal duct, and is articulated with three bones, viz. the superior maxillary, the lacrymal, and palate bone.

The *inferior Maxillary bone*, is somewhat in the shape of a horse-shoe, composed, originally, of two lateral portions united at the symphysis.

It presents externally the incisor fossa, the mental foramen, the external oblique line, the angle of the jaw. Internally we see two tubercles, and depressions below them, the mylo-hyoid ridge and groove, the inferior dental foramen. Along the upper margin are the alveolar processes, the coronoid processes, the sigmoid notch, the neck of the jaw, surmounted by the condyle.

The foramina are two on each side, the mental and inferior dental.

This bone is articulated only with the temporal by ginglymus.

The Muscles attached are:

To the incisor fossa	*Levator labii inferioris.*
external oblique line . .	*Depressor labii inferioris.* *............ anguli oris.* *Platysma.*
tubercles and below at inside of symphysis . .	*Genio-hyoglossus.* *Genio-hyoideus.* *Digastricus.*
mylo-hyoid ridge . . .	*Mylo-hyoideus.* *Superior constrictor pharyngis.*
outside of the ramus . .	*Masseter.*
inside of the ramus . .	*Pterygoideus internus.*
the coronoid process . .	*Temporal muscle.*
to the neck of the jaw .	*Pterygoideus externus.*

THE TEMPORO-MAXILLARY ARTICULATION.

This articulation is formed on each side by the *temporal bone* and the *inferior maxilla;* the *temporal bone* presents for this purpose the *glenoid cavity* and the *transverse root* of the zygoma. The *glenoid cavity*, concave, directed backwards and inwards, descends lower internally than externally, and is divided into two parts, an anterior *articular* and a posterior *non-articular* by the Glasserian fissure; the former only forms the articulation, and is lined by cartilage. The part of the *inferior maxilla* which forms the articulation is the *condyle;* its long axis is directed obliquely backwards and inwards, so that two lines drawn in the direction of both condyles backwards will meet at the foramen magnum; it projects higher externally than internally, is bent slightly forwards, and is incrusted with cartilage, which descends furthest on its anterior surface; externally it presents a tubercle, to which is attached the external lateral ligament; it is supported unequally on the *neck*, so that more of the condyle projects on the inner than on the outer side; at the anterior internal part of the neck is a depression, which gives insertion to the external pterygoid muscle.

THE LIGAMENTS OF THE TEMPORO-MAXILLARY ARTICULATION.

The ligaments of the temporo-maxillary articulation are the *external lateral*, the *internal lateral*, and the *capsular ;* in its interior it possesses an *inter-articular* cartilage, and is lined by *synovial membrane ;* besides these ligaments there are the *stylo-maxillary* and *inter-maxillary*, which, although not immediately connected with the articulation, may be described with it.

The *external lateral ligament* is situated behind the masseter muscle, overlapped by a part of the parotid gland ; it *arises* from the tubercle on the outer extremity of the transverse root of the zygoma, passes downwards and backwards, and is *inserted* into the outer extremity and side of the condyle and neck of the lower jaw.

The *internal lateral ligament* is not closely connected with the articulation. It *arises* narrow and pointed from the spinous process of the sphenoid bone, passes downwards and forwards, expanding and becoming flattened as it descends, and is inserted into the lower and anterior part of the circumference of the dental foramen, sending down a prolongation which covers the mylo-hyoidean groove and nerve ; its *outer surface* corresponds to the synovial membrane and external pterygoid muscle, and is separated from the neck of the condyle by the internal maxillary artery, the inferior dental vessels and nerve ; its *inner surface* corresponds to the internal pterygoid muscle and gustatory nerve.

The *capsular ligament* is not well marked; *superiorly* it is attached to the edge of the Glasserian fissure, around the articular surface of the glenoid cavity, and transverse root of the zygoma, passes downwards, attaches itself to the fibro-cartilage, and is inserted into the condyle of the lower jaw, beneath its articular surface. It is deficient *internally*, where it is perforated by the external pterygoid muscle.

The *stylo-maxillary ligament* is a broad thin ligament, which arises from the styloid process of the temporal bone, passes downwards, forwards, and outwards, and is inserted into the inner edge of the angle of the lower jaw, between the internal pterygoid and masseter muscles, and between the parotid and sub-maxillary glands; it gives an origin to the stylo-glossus muscle, and has attached to it the cervical fascia.

The *inter-maxillary ligament* is a weak indistinct ligament, which arises superiorly from the lower extremity of the internal pterygoid plate, descends, and is inserted into the inferior maxilla, close to the root of the coronoid process, behind the last molar tooth. It gives origin to the buccinator muscle anteriorly, the superior constrictor of the pharynx posteriorly.

On cutting into the articulation, the inter-articular cartilage and synovial membrane will be exposed.

The *inter-articular cartilage* is a thin plate of fibro-cartilage, placed between the bones, and separating the synovial membrane into two sacs. Its *circumference*, thicker than the centre, has attached to it externally the external lateral ligament; internally and anteriorly, the external pterygoid muscle; posteriorly, it is perforated by numerous vessels: it is sometimes perforated in the centre, and then the two synovial sacs communicate. The *synovial membrane* of the articulation is divided into two sacs by the inter-articular cartilage; the *superior* lines the glenoid cavity, the transverse root of the zygoma, and the upper surface of the inter-articular cartilage; the *inferior* covers the under surface of this cartilage, passes from this on the condyle and descends on the neck, which it covers more posteriorly than anteriorly. The temporo-maxillary articulation belongs to the class *Arthrosis.*

THE TEETH.

The *teeth* are of a very hard and compact structure, placed in the alveoli of the upper and lower jaw; their number is almost constantly thirty-two, sixteen in each jaw, but varies in some individuals, being sometimes but twenty-eight; each tooth consists of a *body* or *crown*, a *neck*, and a *fang* or *fangs*. The *body* or *crown* of the tooth is the upper expanded portion which is exposed, destitute of periosteum, and covered by enamel; the *neck* is the contracted part immediately beneath the body, and which is surrounded by the gums; the *fang* or *fangs* are those processes which are sent down into the alveoli, and by means of which the teeth are firmly held in situ. Each tooth contains in its interior a canal, which commences at the root of the fang by a very minute aperture, and from this passes up into the body where it is largest; this cavity assumes somewhat the shape of the tooth, and possesses a distinct process from each fang that it may have; it is smooth internally, and contains a soft membrane and pulpy substance, termed the *pulp* of the tooth: this is supplied with vessels and nerves, although the latter cannot be traced into the body or crown. The crown of the tooth is uncovered by periosteum, but the remaining parts possess this covering from the neck downwards: this is connected also with the socket of the tooth which it lines; at the neck it is firmly attached to the gums.

The *teeth* of each jaw in the adult are divided into

four incisors,
two cuspidati or canine,
four bicuspidati,
six molares or grinders.

The *incisors* are placed in the centre of the jaws, and are the only teeth of which the body is flattened; the fang is single, and marked laterally by a longitudinal groove, flattened in a contrary direction to the crown, that is, laterally, whilst its anterior and posterior surfaces are narrow; the *enamel* is thickest anteriorly; the incisors of the upper jaw are larger than those of the lower; the two middle are the largest, their fangs are rather rounded, and they project more in front so as to overlap the under ones: the middle incisors of the lower jaw are the smallest, the lateral ones larger.

The *cuspidati* or *canine teeth* are placed one on each side external to the incisors; they possess a large and long fang, which causes a remarkable prominence on the outer surface of the alveoli, and extends deep into the bone; the *body* or *crown* is conical, with the apex free, convex, and projecting anteriorly beyond the other teeth, particularly in the lower jaw; those of the upper jaw are much larger than those of the lower; their fangs project higher in the superior maxilla than any of the other teeth, hence they are sometimes called the eye-teeth; the free extremity corresponds with the interval between the lateral incisors and the first bicuspid of the lower jaw.

The *bicuspidati* or small molars are placed two on each side, between the preceding and the molares; their *body* long from before backwards, compressed laterally, terminates in two tubercles, separated by a depression: the anterior of these is the larger and more projecting, and nearly conceals the other; as it approaches the fang it becomes smaller, and has its enamel terminating equally all round; the fang is broad and compressed, deeply grooved laterally, and terminates sometimes, and more frequently in the upper jaw, in a double fang. Those of the upper jaw are broader and flatter than those of the lower; their fangs contain a double cavity, even when a single one exists, one towards each margin. These teeth are more frequently wanting than any other, except the dentes sapientiæ.

The *molares* or *grinders* are three on each side; the first and second resemble one another, the third differs from these: they possess the greatest number of points or prominences on their body, and the greatest number of fangs. Their *body* or *crown* is commonly marked by five prominences, (although it sometimes possesses but four, or even three,) three external and two internal: the external of these are the most projecting and least on a line with the surface of the tooth; between these prominences there is an irregularly depressed surface; the body contracts but little towards the neck, and terminates by dividing into two, three, four, or five fangs, most frequently three, two being external and one internal, all of which possess an opening at their summit, leading into the cavity of the tooth; the enamel covers more of the free than their lateral surfaces. The *first* molar tooth is the largest and strongest; its crown possesses five tubercles; its fangs in the upper jaw are three in number; most frequently two external and one internal; it sometimes possesses four or five; the fangs of this tooth in the lower jaw are most frequently double, and are placed across the alveoli, so that one is posterior to the other; each fang possesses two cavities, one near each edge. The *second* molar tooth is a little smaller than the preceding; its crown possesses but four tubercles in the lower jaw; its fangs are as the preceding, three in the upper, two in the lower jaw; the external fangs of both teeth are nearly vertical, whilst the internal, stronger, diverges from them internally, so as to afford considerable resistance to the extraction of the tooth, and frequently to cause a fracture of the alveoli. The *third* molar tooth is the smallest and most irregular; its crown possesses three or four tubercles; it possesses one, two, or three fangs, most frequently one in the lower jaw; they are shorter than those of the preceding, and do not diverge to the same extent; they are directed forwards, so as to support the second molar tooth: this tooth in the upper jaw is smaller than that of the lower, hence the two rows of teeth meet exactly at the posterior extremity. The last molar teeth have received the name of *dentes sapientiæ*, from their not appearing till the age of about twenty-one; they decay shortly after their appearance and are often wanting.

Structure. The teeth are composed of two materials, a *bony* portion, and a dense structure, termed the *enamel*; the bony portion forms the whole of the tooth, except its external surface, where it is exposed to friction, and is here, therefore, covered by enamel; although termed bone, it differs so much from the osseous structure in general that some anatomists have considered it to bear much resemblance to ivory; it is much more dense and compact than any other bony substance, but not so hard as the enamel; its fracture has a fibrous appearance, the fibres being disposed in laminæ, running from the apex of the fang to the base or cutting surface of the tooth; it does not contain reticular tissue or medullary cells; it is, however, composed of animal and earthy substance.

The *enamel* is that white substance which covers the teeth where they are exposed, and is the hardest structure in the human body, producing sparks with steel: it is of a milk white colour, and is capable of a high degree of polish; it appears to be one uniform mass, but is composed of fibres which are placed perpendicularly, some to the centre, and some to the surface of the bony portion, in order that they may better resist the effects of friction, it is thickest where most exposed: the enamel is not vascular, and is perhaps the least organized structure in the living body; its chemical composition is the same as that of the bony portion, except that it contains more fluate of lime and less animal matter.

GROWTH OF THE TEETH.

The lower jaw and alveolar processes are very early developed in the fœtus, being called into exercise immediately after birth. About the third or fourth month of fœtal life there exists in each jaw, instead of alveoli, a longitudinal groove, deep and narrow anteriorly, shallower and wider posteriorly, divided by bony ridges into superficial depressions, along the bottom of which run the dental vessels and nerves; after a short time processes are sent across from one edge of the groove to the other, so as to completely divide it into distinct cavities, and form the alveoli; these grow with the teeth, or even advance more rapidly, and at last nearly inclose them, becoming contracted towards their mouths; in these depressions, about the third or fourth month, soft vascular substances, termed *pulps*, begin to be formed, on which the bony part of the tooth is afterwards to be deposited; they are not distinct so early, but become so about the fifth month, when four or five pulps are manifest; the pulps of those teeth which appear first are first formed, viz. the middle incisors, then the lateral incisors and small grinders, and last the cuspidati and large grinders, no bicuspids existing in the temporary teeth; each pulp in shape resembles the body of the tooth which is to be formed on it: it is soft and vascular, particularly where it is in contact with the part of the tooth deposited, so much so that it may be here deeply coloured with injection; on the free surface of the pulp, ossification commences by as many points as there are prominences on each tooth, there being three in the incisors, one in each of the cuspidati, four or five in the molars, and two in the bicuspids when they are forming: these different points afterwards coalesce; the ossification proceeding from without inwards, that part which is first formed is the most external, and is in contact with the enamel; in this way ossification proceeds, until it is so far advanced that it contracts the size of the pulp, and at last completely surrounds it, except at its base, leaving, in this manner, the cavity already described as existing in each tooth; the adhesion of the pulp to the newly formed tooth is but slight, as they can be easily separated without injuring any apparent vascular connexion. At first the *body* of the tooth alone is formed, when this is completed it begins to contract, and becomes somewhat rounded, forms the neck, and from this then the fang or fangs commence; these form by the elongation of the pulp, and the deposit of bony matter on it, and at last increase to such an extent as to cause the elevation of the body of the tooth above the gum, the alveoli at the same time contracting so as to embrace the fang; as ossification proceeds, the extremity of the ossified part is thin, elastic, and transparent, and has received the name of *substantia cornea;* when one fang alone is formed the pulp sends down but one process; when two or more fangs are to be formed, a like number of processes elongate from the body of the pulp, which are afterwards separated by bony partitions, sent across from the bony margin of the cavity in the body of the tooth. When the tooth first appears through the gum, it is very imperfect in structure, its fang is but badly developed, and its cavity is large. In this way the bony part of the tooth is formed on the pulp, but how deposited is not perhaps to be explained.

The *enamel* is deposited in a different manner; for this purpose the pulp is inclosed by a membrane, divided into as many bags or cells as there are teeth forming at the time; they are of a whitish appearance externally, but very vascular internally, and are termed the *capsules*. It is the inner surface of these which secretes the enamel, its outer surface adhering firmly to the gum. This membrane deposits the enamel shortly after the tooth begins to be formed, in greatest quantity where most is required, as mentioned in the description of the teeth; it is at first soft, moist, and rough, but when it has acquired the full degree of thickness, it assumes its natural shining and polished appearance; it is completed when the tooth appears through the gum. At this time the capsule having performed its office loses its vascularity, becomes absorbed so as to allow of the exit of the tooth, and finally descends so as to form the periosteum of the fang, and becomes adherent to it.

The teeth which are first formed, and which appear shortly after birth, are termed the *temporary* or *deciduous* teeth, because, at about the age of seven or eight, they fall out, and are replaced by the *adult* or *permanent* set: there are ten temporary teeth in each jaw, viz.

four incisors,
two cuspidati,
four molares or grinders.

The time at which they cut through the gum is variable, but they generally appear in the following order, commencing about the sixth or seventh month after birth:

the middle incisors of the under jaw,
the middle of the upper,
the under lateral incisors,
the upper lateral incisors,
anterior molars or grinders of under jaw,
anterior of upper,
the cuspidati and first those in the lower jaw,
the posterior or larger grinders.

Their appearance is completed about the second or third year, some weeks or months generally elapsing between each set.

The formation of the *permanent teeth* is precisely the same as that of the temporary, viz. by the production of pulps and capsules; the pulps which form them are derived from those of the temporary teeth which send prolongations or processes backwards from their posterior surface for their formation, with the exception of the permanent molares; these, from having no temporary teeth to correspond to, as the bicuspids take the place of the temporary molares, are produced from pulps formed for them, and which have no connexion, as is generally thought, with the pulps already formed. The connexion between the pulps of the temporary and permanent teeth is at first intimate, being both contained in the same socket; according as they advance, however, they separate, and the permanent teeth are lodged in distinct bony cells, which are situated below and behind the temporary cells in the inferior maxilla; above and behind them in the superior; ossification has commenced on them about the age of six or seven months, and their formation is considerably advanced when the temporary incisors have appeared: they gradually increase in size until the temporary teeth are shed to make room for them, by the gradual absorption of their fangs, and the consequent loss of connexion with the alveoli; the dentes sapientiæ being the last formed, not commencing till the eighth or ninth year. From the preceding description it may be seen that the number of teeth formed and forming in the jaws at different periods is variable; at the time of birth, each jaw contains the rudiments of the ten temporary teeth, the anterior adult molares and incisors, if not cuspidati; the greatest number exists about the age of six years, just before the shedding of the temporary set, each jaw then containing twenty-four teeth, viz. both the temporary and permanent set, except the dentes sapientiæ; and in some cases these also. The permanent teeth do not appear in the same order as the temporary: the *anterior molares* appear first, then the *middle lower incisors;* next, the *middle* of the *upper* jaw; after these the *lateral incisors* appear, and first those of the *lower* jaw; the temporary molares are shed before the cuspidati, and their place supplied by the *bicuspids;* shortly after these, and frequently before the appearance of the second bicuspid, the *cuspidati* appear; the *middle permanent molares* appear next, and the *dentes sapientiæ* last of all.

THE OS HYOIDES.

The *os hyoides* is placed in the anterior and upper part of the neck, having no osseous connexion with any other bone; it is somewhat arched, convex anteriorly, concave posteriorly, and is divided into *body*, *cornua*, and *appendices.* The *body* occupies the central part, and is the largest; it is quadrilateral. Its *anterior surface*, convex, is divided by a horizontal ridge, most prominent in the centre, into two portions, which are subdivided into two by a central vertical ridge,—these give attachment from below upwards to the digastric, stylo-hyoid, mylo-hyoid, genio-hyoid, and genio-hyo-glossus muscles; its *posterior surface*, smooth and concave, corresponds to a quantity of yellow cellular tissue, which separates it from the epiglottis; its *inferior edge* gives attachment anteriorly to the sterno-hyoid, omo-hyoid, and thyro-hyoid muscles, and behind these to the thyro-hyoid ligament: its *superior edge* gives origin to the hyo-glossus muscle; at either *extremity* it presents a convex cartilaginous surface, by which it is joined to the cornua. The *cornua* are two in number, one on each side; they are longer, but not so strong as the body; at their anterior extremity they are marked by a concave articular surface, where they are connected to the body; from this they pass upwards and backwards, becoming gradually smaller, and terminate in a small round head covered by cartilage. *Superiorly*, they give attachment to the hyo-glossus and middle constrictor of the pharynx; *inferiorly*, to the thyro-hyoid membrane; *externally*, to the thyro-hyoid and digastric muscles; *internally*, they are covered by the mucous membrane of the pharynx. The *appendices* or *lesser cornua* are pyramidal in shape; they pass upwards and backwards from near the junction of the body and great cornua, and terminate posteriorly in a point; they give attachment inferiorly to the genio-hyo-glossus muscle; *superiorly*, to the stylo-hyoid ligament.

The *structure* of the os-hyoides is chiefly spongy, but the cornua possess more compact tissue; it is developed by five points of ossification, one for each of its pieces, which in advanced life become united, so as to form but one bone. The *articulations* of the os hyoides consist of those between its different pieces just described, and which possess unimportant ligaments, and are lined by synovial membrane: they disappear in advanced life. It is connected to the temporal bone by means of the *stylo-hyoid ligament*, which arises narrow and pointed from the styloid process of the temporal bone, descends forwards and inwards, becoming expanded, and is inserted into the lesser cornu of the os hyoides. This is exceedingly variable as to size, and is sometimes converted into bone, when the styloid process appears to be elongated as far as the os hyoides.

MUSCLES.

MUSCLES OF THE CRANIAL REGION.

Occipito-frontalis. *Origin.* Two external thirds of the superior transverse ridge of the occipital bone and posterior and external part of mastoid process of temporal bone.

Insertion. Integuments of the eyebrows, the fibres blending with those of the corrugator supercilii and orbicularis palpebrarum, and by a slip named *pyramidalis nasi*, to the nasal bones and internal angular process of the os frontis.

Use. To elevate the eyebrows, make tense the upper eyelid, corrugate the forehead in a transverse direction, and to move the scalp forwards or backwards.

MUSCLES OF THE EXTERNAL EAR.

Superior Auris. *Or.* Cranial aponeurosis above the external ear.

Ins. Upper and anterior part of the cartilage of the ear.

Use. This muscle, also named *attollens aurem*, raises the cartilage, and thus deepens its cavity.

Anterior Auris. *Or.* Posterior part of the zygomatic process and cranial aponeurosis.

Ins. Anterior part of the helix.

Use. To draw the ear forwards and somewhat upwards. It is named *attrahens aurem.*

Posterior Auris. *Or.* Mastoid process, above sterno-mastoid muscle.

Ins. Back part of the concha.

Use. To draw the ear backwards. It consists of two or three bundles of fibres, and is also named *retrahens* or *retrahentes aurem.*

MUSCLES OF THE FACE.

ORBICULARIS PALPEBRARUM. *Or.* Internal angular process of the os frontis and upper edge of the tendo-oculi.

Ins. Nasal process of the superior maxillary bone and inferior edge of the tendo-oculi.

Use. To close the eyelids, press the tears towards the puncta, depress the eyebrow, raise the cheek, and slightly to compress the lacrymal sac.

TENSOR TARSI. *Or.* Posterior edge of os unguis.

Ins. Lacrymal ducts as far as the puncta.

Use. To compress the lacrymal sac and caruncula, and to draw the puncta closer to the eye. It is also named Dr. Horner's muscle.

CORRUGATOR SUPERCILII. *Or.* Internal angular process of os frontis.

Ins. Middle of the eyebrow, its fibres blending with the occipito-frontalis and orbicularis palpebrarum.

Use. To approximate the two eyebrows, and thus throw the forehead into vertical wrinkles.

PYRAMIDALIS NASI arises from the occipito-frontalis muscle, and is indeed part of it; it descends along the nasal bones to the compressor nasi muscle, into which it is inserted; it is sometimes wanting.

COMPRESSOR NASI. *Or.* Canine fossa in the superior maxilla.

Ins. Dorsum of the nose.

Use. To compress the cartilages of the nose, or to draw them laterally.

LEVATOR LABII SUPERIORIS ALÆQUE NASI. *Or.* The upper extremity of the nasal process of the superior maxillary bone, and from the edge of the orbit above infra-orbital hole.

Ins. Ala nasi, the upper lip, and orbicularis oris muscle. The second origin of this is considered by some to be a separate muscle, named *levator labii proprius.*

ZYGOMATICUS MINOR. *Or.* Upper part of the malar bone.

Ins. Upper lip, near the commissure, sometimes wanting.

Use. To raise the upper lip, as in smiling and laughing.

ZYGOMATICUS MAJOR. *Or.* Lower part of the malar bone, near the zygomatic suture.

Ins. The angle of the mouth.

Use. To raise the angle of the mouth in the same cases as the former.

LEVATOR ANGULI ORIS. *Or.* Canine fossa below infra-orbital foramen, above alveola of first molar tooth.

Ins. The commissure of lips and the orbicularis oris.

DEPRESSOR LABII SUPERIORIS ALÆQUE NASI. *Or.* The myrtiform fossa, and alveoli of canine and incisor teeth, of superior maxilla.

Ins. Integuments of the upper lip and the fibro-cartilage of the septum and ala nasi.

DEPRESSOR ANGULI ORIS. *Or.* External oblique line on the lower jaw, extending from the anterior edge of masseter to the mental foramen. It is also named *triangularis oris.*

Ins. Commissure of the lips.

Depressor labii inferioris. *Or.* Side and front of the lower maxilla, above its base.

Ins. Half of the lower lip and the orbicularis oris.

Levator labii inferioris *Or.* Alveoli of the incisor teeth of lower jaw, by the side of the symphysis.

Ins. The integuments of the chin.

Use. To raise the lower lip, and from raising the chin is also named *levator menti.*

Orbicularis oris surrounds the mouth by two fleshy fasciculi. Its fibres blend with those of the several muscles inserted into the lips.

Use. To approximate the lips, close the mouth, and antagonize the other muscles.

Buccinator. *Or.* The last two alveoli of the superior maxilla and external surface of posterior alveoli of the lower maxilla, also the inter-maxillary ligament.

Ins. Commissure of the lips.

Use. To press the cheek against the teeth, to diminish the cavity of the mouth, and to draw back the angle of the mouth. It is perforated by the *stenonian* duct.

MUSCLES OF THE LOWER JAW.

Masseter consists of two portions:

Anterior portion. *Or.* Superior maxilla, where it joins the malar bone, and from the inferior edge of the latter.

Ins. Outer surface of the angle of the lower jaw, the fibres passing downwards and backwards.

Posterior portion. *Or.* Edge of the malar bone and zygomatic arch, as far as the glenoid cavity.

Ins. External side of the angle and ramus of the lower jaw. Some of these fibres pass downwards and forwards, so that the two portions of this muscle decussate each other.

Use. To raise the lower jaw, the anterior fibres acting alone, will draw the jaw forwards and upwards, the posterior ones upwards and backwards.

Temporalis. *Or.* Side of cranium, beneath semicircular ridge on parietal bone, temporal fossa, and aponeurosis, the malar bone and inside of zygomatic arch.

Ins. The coronoid process of inferior maxilla as far as the last molar tooth.

Use. To raise the lower jaw, carry it somewhat forwards or backwards, and by its lower transverse fibres may assist in its rotation.

Pterygoideus internus. *Or.* Inner side of the external pterygoid plate and pterygoid process of the palate bone, occupying pterygoid fossa.

Ins. Inner side of the angle of the jaw, and into the rough surface above it.

Use. Separately, to rotate the jaw carrying it to the other side; but acting with the opposite muscle to raise the lower jaw.

Pterygoideus externus. *Or.* Outer side of the external pterygoid plate, from the crest on the great ala of the sphenoid bone and from the back part of the tuberosity of the superior maxillary bone.

Ins. Into the anterior and internal part of the neck of the lower jaw, the inter-articular cartilage, and inferior synovial membrane.

Use. To rotate the lower jaw, carry it forwards, and to draw forwards the inter-articular cartilage.

MUSCLES ON THE ANTERIOR AND LATERAL PARTS OF THE NECK.

Platysma-myoides. *Or.* The cellular membrane covering the upper and outer part of the deltoid and great pectoral muscles.

Ins. The chin, the fascia along the side of the lower jaw, and the fascia covering the parotid gland. Some of its fibres ascend to blend with the depressor anguli oris, the zygomatic and orbicularis palpebrarum.

Use. To depress the angle of the mouth and lower jaw, to steady the head in carrying heavy weights upon it, and to compress and to bind down the soft parts of the side of the neck.

Sterno-cleido mastoideus. *Or.* Tendinous from upper and anterior part of the first bone of the sternum, and fleshy from sternal third, sometimes half of the clavicle.

Ins. Upper part of the mastoid process and external third of the superior transverse ridge of the occipital bone.

Use. The anterior fibres will turn the face to the opposite side, the posterior fibres will draw the head towards the chest; the two muscles will bring the head forwards, but if the muscles of the neck be in action they may carry the head still further backwards, as in tetanus.

Sterno-hyoideus. *Or.* Posterior surface of the first bone of the sternum, the cartilage of the first rib, the sternal end of clavicle, and the sterno-clavicular capsule.

Ins. The lower border of the body of the os hyoides.

Use. To depress the os hyoides, and with it the larynx.

Sterno-thyroideus. *Or.* Posterior surface of the first bone of the sternum and the cartilage of the second rib.

Ins. Oblique line on the ala of the thyroid cartilage.

Use. To depress the larynx.

Omo-hyoideus. *Or.* Behind the semi-lunar notch in the superior costa of scapula, from the ligament which passes over the notch, from the base of the coracoid process, and sometimes from the acromial end of the clavicle.

Ins. Lower border of the os hyoides, at the junction of its body and the great cornu.

Use. To depress the os hyoides, and draw down the larynx and pharynx.

Digastric. *Or.* A groove in the os temporis, internal to the mastoid process.

Ins. A rough depression on the inner side of the base of the jaw, near the symphysis.

Use. To raise the os hyoides and draw it either backwards or forwards, and when this bone is fixed it depresses the lower jaw. The central tendon perforates the stylo-hyoid muscles, and is attached to the cornu of the os hyoides by a strong fascia.

Mylo-hyoideus. *Or.* Mylo-hyoid ridge on the inner surface of side of the inferior maxilla.

Ins. Base of os hyoides, chin, and middle tendinous line common to it and its fellow.

Use. To raise the os hyoides and press the tongue upwards, or depress the lower jaw.

Genio-hyoideus. *Or.* Inner side of the chin, above the digastricus.

Ins. Base of the os hyoides.

Use. To raise the os hyoides upwards and forwards, to help in protruding the tongue, and to depress the lower jaw when the hyoid bone is fixed.

Hyo-glossus. *Or.* Cornu adn part of the body of the os hyoides.

Ins. The side of the tongue.

Use. To depress the side of the tongue, and make its surface convex.

Genio-hyo-glossus. *Or.* Eminence inside the chin, below the frœnum linguæ.

Ins. The mesial line of the tongue from its apex to its base, and into the body and lesser cornu of the os hyoides.

Use. To raise the os hyoides, and protrude the tongue; but some of the fibres can retract, others in the middle render it concave: it may also depress the lower jaw.

Lingualis consists of fasciculi of fibres, running from the base to the apex of the tongue, and lying between the genio-hyo-glossus and the hyo and stylo-glossi.

Use. To shorten the tongue.

STYLOID MUSCLES.

Stylo-hyoideus. *Or.* The outer side of the styloid process, near its base.

Ins. Cornu and body of the os hyoides, and into the fascia connecting the tendon of the digastric to this bone.

Use. To draw the os hyoides upwards and backwards.

Stylo-glossus. *Or.* Styloid process, near the tip, and the stylo-maxillary ligament.

Ins. Side of the tongue, as far as the tip.

Use. To draw the tongue upwards and to one side, and to raise the apex of the tongue behind the upper incisor teeth.

Stylo-pharyngeus. *Or.* Back part of the root of the styloid process.

Ins. Side of pharynx, the cornu of the os hyoides, and thyroid cartilage.

Use. To raise the pharynx, dilate it, and draw it forward.

MUSCLES OF THE PHARYNX.

The muscles of the pharynx are described from below upwards, in consequence of the inferior being most superficial; the middle next, and the superior deepest. The stylo-pharyngeus muscle has been just described, and classed with the styloid muscles; the palato-pharyngeus will be given with the muscles of the palate. The remaining muscles are called constrictors, and are three in number.

CONSTRICTOR PHARYNGIS INFERIOR. *Or.* The side of the cricoid cartilage, the inferior cornu, and posterior part of the ala of the thyroid cartilage.

Ins. With its fellow, along mesial line on the back of the pharynx.

CONSTRICTOR PHARYNGIS MEDIUS. *Or.* Cornu and appendix of the os hyoides, also stylo-hyoid and thyro-hyoid ligaments.

Ins. Mesial tendinous line of the pharynx and the basilar process of the occipital bone.

CONSTRICTOR PHARYNGIS SUPERIOR. *Or.* Petrous portion of temporal bone, lower part of the internal pterygoid plate and hamular process of the sphenoid bone, also from inter-maxillary ligament, the posterior third of the mylo-hyoid ridge, and side of the base of the tongue.

Ins. Basilar process of occipital bone and mesial line of pharynx.

Use. The chief use of this, as well as of the other two muscles, is to contract the tube of the pharynx successively from above downwards, during the passage of the food.

MUSCLES OF THE SOFT PALATE.

The palate contains the five following muscles on each side:

LEVATOR PALATI. *Or.* Petrous portion of temporal bone in front of the foramen caroticum, and behind Eustachian tube.

Ins. Broad, into the velum.

TENSOR, VEL CIRCUMFLEXUS PALATI. *Or.* Depression at the root of internal pterygoid plate, from spinous process of the sphenoid bone and fore part of Eustachian tube; its tendon turns round hamular process (hence called circumflexus palati.)

Ins. By a broad expansion into the velum, meeting its fellow in the mesial line.

Use. To render the velum tense when drawn up by the former muscle.

MOTORES UVULÆ, called also *azygos uvulæ*, in consequence of both muscles running close to each other. *Or.* Posterior extremity of the spine of the palate bones.

Ins. Cellular tissue of the uvula.

Use. To elevate and shorten the uvula.

PALATO-GLOSSUS forms the anterior pillar of the palate. *Or.* The inferior surface of velum.

Ins. The side of the tongue.

Use. To depress the velum or raise the edge of the tongue, and to constrict the isthmus of the fauces.

PALATO-PHARYNGEUS forms the posterior pillar of the palate. *Or.* Inferior surface of the palate.

Ins. Side and back of the pharynx, and the superior cornu of the thyroid cartilage.

Use. To depress the velum, or to raise the pharynx.

MUSCLES OF THE LARYNX.

The muscles of the larynx are symmetrical, and are situated on its front, sides, and back part. There are two on the fore part, viz. thyro-hyoid and crico-thyroid. Two laterally, viz. thyro-arytenoid and lateral crico-arytenoid. Two posteriorly, viz. arytenoid and posterior crico-arytenoid.

THYRO-HYOIDEUS. *Or.* Oblique ridge on the ala of the thyroid cartilage.

Ins. Lower edge of the cornu of the os hyoides.

Use. To raise the larynx and carry it forwards; and also to depress and fix the os hyoides.

CRICO-THYROIDEUS. *Or.* Fore part of the cricoid cartilage.

Ins. Lower border of the thyroid cartilage.

Use. To approximate the two cartilages, and, according to some, to dilate the rima glottidis.

THYRO-ARYTENOIDEUS. *Or.* Posterior surface of the thyroid cartilage, near its angle.

Ins. Anterior edge of the arytenoid cartilage.

Use. To contract the rima glottidis, and compress the sacculus laryngis.

CRICO-ARYTENOIDEUS LATERALIS. *Or.* Upper edge of the side of the cricoid cartilage.

Ins. Base of the arytenoid cartilage.

Use. To contract the rima glottidis from before backwards, but dilate it from side to side.

CRICO-ARYTENOIDEUS POSTICUS. *Or.* Depression on the posterior surface of the cricoid cartilage.

Ins. Outer side of the base of the arytenoid cartilage.

Use. To dilate the rima glottidis.

ARYTENOIDEUS fills the interval between arytenoid cartilages, and consists of two arrangements of fibres: *oblique*, which run from apex of one cartilage to base of opposite one; and *transverse*, which are attached to posterior surface of each cartilage.

Use. To approximate the arytenoid cartilages, and contract the rima glottidis.

DEEP MUSCLES ON ANTERIOR AND LATERAL PARTS OF THE NECK,

Which lie close to the vertebræ, and are exposed by removing the pharynx, larynx, and cervical vessels and nerves.

Longus colli. *Or.* Bodies of three superior dorsal and four inferior cervical vertebræ, from the intervertebral ligaments, the head of the first rib, and the anterior tubercles of the transverse processes of the four inferior cervical vertebræ.

Ins. Fore part of the first, second, and third cervical vertebræ.

Use. To bend the neck towards one side, and rotate the atlas on the dentata; both will draw the neck forwards.

Rectus capitis anticus major. *Or.* Anterior tubercles of transverse processes of the four inferior cervical vertebræ.

Ins. Basilar process of the occipital bone.

Use. To bend the neck and head forwards.

Rectus capitis anticus minor. *Or.* Transverse process of the atlas.

Ins. Basilar process of the occipital bone.

Use. To bend the head forwards and on one side.

Rectus capitis lateralis. *Or.* Transverse process of the atlas.

Ins. Jugular process of the occipital bone.

Use. To bend the head forwards and to the side.

Scalenus anticus. *Or.* Anterior tubercles of transverse processes of the third, fourth, fifth, and sixth cervical vertebræ.

Ins. Upper surface of the first rib, near its cartilage.

Use. To raise and fix the first rib, and to bend the neck forwards and laterally.

Scalenus medius. *Or.* Posterior tubercles of the transverse processes of four or five inferior cervical vertebræ.

Ins. Upper edge of second rib.

Use. To raise the second rib, and bend the neck laterally.

Scalenus posticus. *Or.* Posterior tubercles of two or three inferior cervical vertebræ.

Ins. Upper edge of the second rib between its tubercle and angle.

Use. To raise the second rib, and incline the neck laterally, and a little backward.

MUSCLES OF THE THORAX.

Pectoralis major. *Or.* Sternal half of the clavicle, anterior surface of sternum, the cartilages of the third, fourth, fifth, and sixth true ribs, and from aponeurosis common to it and the external oblique muscle.

Ins. By a flat tendon into the anterior edge of the bicipital groove, and by an aponeurosis into the fascia of the forearm.

Use. To draw the arm forwards and inwards; and, if separate parts act, to raise the arm, draw it forwards, or bring it to the side. When the arm is raised it elevates the ribs, as in forced inspiration.

Pectoralis Minor. *Or.* External surfaces and upper edges of the third, fourth, and fifth true ribs, sometimes from the second.

Ins. Inner and upper surface of the coracoid process of scapula.

Use. To draw the shoulder forwards, inwards, and downwards, and to elevate the ribs in forced inspiration.

Subclavius. *Or.* Cartilage of the first rib.

Ins. External half of the inferior surface of the clavicle, extending to between conoid and trapezoid ligaments.

Use. To bring the clavicle downwards and forwards, or raise the first rib.

Serratus magnus. *Or.* By eight or nine fleshy slips, from eight or nine superior ribs.

Ins. Base of scapula, especially superior and inferior angles.

Use. To carry the scapula forwards, and elevate the shoulder-joint, and when the shoulder is fixed to elevate the ribs.

Intercostales are 22 in number on each side: 11 *internal*, and 11 *external.*

External. *Or.* Inferior edge of each rib, commencing at the transverse processes of the vertebræ.

Ins. External lip of the superior edge of the rib beneath, extending to behind the costal extremities of the cartilages.

Internal. *Or.* At sternum from the inner lip of the lower edge of each cartilage and rib as far as the angle.

Ins. Inner lip of the superior edge of the cartilage and rib beneath.

Use. To raise the ribs, when the first and second are fixed by the scaleni.

Levatores costarum. *Or.* Extremity of each dorsal transverse process.

Ins. Upper edge of the rib below, between its tubercle and angle.

Use. To raise the ribs.

Triangularis sterni. *Or.* Posterior surface and edge of the lower part of the sternum and ensiform cartilage.

Ins. Cartilages of fourth, fifth, and sixth ribs.

Use. To draw down the ribs towards the ensiform cartilage.

MUSCLES OF THE BACK.

Many of them are indistinct, and are subject to variety: they are arranged in four successive layers.

First Layer.

Trapezius. *Or.* Internal third of the superior transverse ridge of the occipital bone, the ligamentum nuchæ, and the spinous process of the last cervical and all the dorsal vertebræ.

Ins. Posterior border of the external third of the clavicle and acromion process, also the superior edge of the spine of the scapula.

Use. To elevate the shoulder and draw it backwards; to incline the head backwards and to one side.

Latissimus dorsi. *Or.* Six inferior dorsal spines, and by lumbar fascia from all the lumbar spines, from the back of the sacrum, the posterior third of the crest of the ilium, and from three or four inferior ribs.

Ins. Inner or posterior edge of the bicipital groove of humerus.

Use. To depress the arm and shoulder, to carry the arm inwards and backwards, and to compress the ribs; but if the arm be raised, it may elevate them, as in forced inspiration.

Second Layer.

Rhomboideus minor. *Or.* Lower part of the ligamentum nuchæ and from the last cervical spinous process.

Ins. Base of scapula, opposite to and above its spine.

Use. To raise the scapula, and thus carry the shoulder backwards.

Rhomboideus major. *Or.* Four or five superior dorsal spines.

Ins. Base of the scapula from the spine to the inferior angle.

Use. As the last; and lower fibres, by acting on the inferior angle, may rotate the shoulder and depress the acromion.

Levator anguli scapulæ. *Or.* Posterior tubercles of transverse processes of the four or five superior cervical vertebræ.

Ins. Vertebral margin of the scapula, between the spine and superior angle.

Use. To raise the angle of the scapula so as to cause depression of the acromion.

Serratus posticus superior. *Or.* Ligamentum nuchæ, and two or three dorsal spines.

Ins. Second, third, and fourth ribs, external to their angles.

Use. To raise the ribs, draw them outwards, and expand the thorax.

Serratus Posticus inferior. *Or.* Two last dorsal and two superior lumbar spines.

Ins. Lower edges of the four inferior ribs anterior to their angles.

Use. To depress the lower

ribs, and to fix them in forced inspiration.

SPLENIUS COLLI. *Or.* Spines of the third, fourth, fifth, and sixth dorsal vertebræ.

Ins. Transverse processes of three or four superior cervical vertebræ.

Use. To bend the neck backwards and to one side.

SPLENIUS CAPITIS. *Or.* Spines of two superior dorsal, and three inferior cervical vertebræ and the ligamentum nuchæ.

Ins. Posterior part of the mastoid process, and the occipital bone, below its superior transverse ridge.

Use. To bend back the head, and each may incline it laterally.

Third Layer.

SACRO-LUMBALIS. *Or.* Posterior third of the crest of the ilium, the oblique and transverse processes of the sacrum, sacro-iliac ligaments, and transverse and oblique processes of the lumbar vertebræ.

Ins. All the ribs, near their angles.

Use. To bend the spine backwards, and somewhat to one side, and to compress the ribs.

LONGISSIMUS DORSI. *Or.* Posterior surface of the sacrum, and transverse and oblique processes of lumbar vertebræ.

Ins. All the dorsal vertebræ, and all the ribs between their tubercles and angles.

Use. To support the spine, and bend it backwards and to one side.

SPINALIS DORSI. *Or.* Two superior lumbar and three inferior dorsal spines.

Ins. Nine superior dorsal spines.

Use. Like the former.

MUSCULI ACCESSORII. *Or.* Superior edge of each rib.

Ins. Tendons of the sacro lumbalis.

Use. To assist the former.

CERVICALIS DESCENDENS. *Or.* From four or five superior ribs, between their tubercles and angles.

Ins. Transverse processes of fourth, fifth, and sixth cervical vertebræ.

Use. To bend the neck backwards and laterally, and may raise the ribs.

TRANSVERSALIS COLLI. *Or.* Transverse processes of five or six superior dorsal vertebræ.

Ins. Transverse processes of three or four inferior cervical vertebræ.

Use. Much the same as the former.

TRACHELO-MASTOIDEUS. *Or.* Transverse processes of three or four superior dorsal vertebræ, and as many inferior cervical.

Ins. Inner and back part of the mastoid process.

Use. To extend the neck, carry the head backwards, and incline it to one side.

COMPLEXUS. *Or.* Transverse and oblique processes of three or four inferior cervical and five or six superior dorsal vertebræ.

Ins. Close to its fellow, into the occipital bone, between its two transverse ridges.

Use. To carry the head backwards, fix, or rotate it.

Fourth Layer.

SPINALIS COLLI. *Or.* Extremities of the transverse processes of five or six superior dorsal vertebræ.

Ins. By four heads into the spines of the second, third, fourth, and fifth cervical vertebræ.

Use. To bend the neck backwards, and incline it to one side.

SEMISPINALIS DORSI. *Or.* By five or six tendons, from the transverse processes of the dorsal vertebræ, from the fifth to the eleventh.

Ins. Extremity of the spines of the two inferior cervical and three or four superior dorsal vertebræ.

Use. To extend the neck and back, and incline it to one side, and to support the trunk.

MULTIFIDUS SPINÆ. *Or.* First fasciculus arises from the spine of the vertebra dentata, and is inserted into the transverse process of third, each successively in a similar manner down to the last, which arises from the spine of the last lumbar vertebra, and is inserted into the false transverse process of the sacrum.

Use. To support the spine, bend it backwards and laterally, and rotate the vertebræ on each other.

INTERSPINALES are situated between the spinous processes of the vertebræ: they are most distinct in the neck.

Use. To approximate the processes, and extend the spine.

INTERTRANSVERSALES are attached and situated as their name implies.

Use. To support the spine, and incline it to one side.

RECTUS CAPITIS POSTICUS MAJOR. *Or.* From the spinous process of the second vertebra.

Ins. Inferior transverse ridge of the os occipitis.

Use. To bend the head backwards, and rotate it.

RECTUS CAPITIS POSTICUS MINOR. *Or.* Posterior part of the atlas.

Ins. Occipital bone, behind the foramen magnum.

Use. To draw the head backwards.

OBLIQUUS CAPITIS INFERIOR. *Or.* Spinous process of the second vertebra.

Ins. Extremity of the transverse process of the atlas.

Use. To rotate the atlas and head on the vertebra dentata.

OBLIQUUS CAPITIS SUPERIOR. *Or.* Upper part of the transverse process of the atlas.

Ins. Occipital bone, between its transverse ridges, posterior to the mastoid process.

Use. To incline the head to one side, and carry it a little backwards.

UPPER EXTREMITY.

The muscles of the upper extremity are divided into those of the shoulder and arm, forearm and hand.

Shoulder and Arm.

Deltoides. *Or.* Lower edge of the spine of the scapula, the anterior edge of the acromion, and the external third of the clavicle.

Ins. Rough surface on the outer side of the humerus, near its centre.

Use. To raise the arm, and by its separate parts to carry it forwards or backwards, thus rotating it outwards and inwards.

Supraspinatus. *Or.* All the scapula above the spine, which forms the supra-spinous fossa, and from the fascia covering the muscle.

Ins. Upper and fore part of the great tuberosity of the humerus.

Use. To raise the arm and abduct it, also to elevate the capsular ligament.

Infraspinatus. *Or.* Inferior surface of the spine and dorsum of the scapula beneath, as low down as the posterior ridge on its inferior costa.

Ins. Middle of the great tuberosity of the humerus.

Use. To raise the arm, draw it backwards, rotate it outwards, and strengthen the capsular ligament.

Teres minor. *Or.* Depression between the two ridges on the inferior costa of scapula, from the fascia covering it, and from the ligamentous septa.

Ins. Inferior depresson on the great tuberosity of the humerus.

Use. To assist the former.

Subscapularis. *Or.* All the surface and circumference of subscapular fossa.

Ins. Lesser tubercle of humerus.

Use. To strengthen the joint internally, carry the arm backwards, and rotate it inwards.

Teres major. *Or.* Rough surface on the inferior angle of the scapula, below the infra spinatus.

Ins. Posterior or inner edge of the bicipital groove, behind the insertion of the latissimus dorsi.

Use. To draw the humerus downwards and backwards, and rotate it inwards.

Coraco-brachialis. *Or.* Point of the coracoid process and the tendon of the short head of the biceps.

Ins. Internal side of the humerus, about its middle, and by an aponeurosis, into the ridge leading to the internal condyle.

Use. To adduct the arm, raise it, bring it forwards, and rotate it outwards.

Biceps. *Or.* Short head, from the coracoid process, the long head, from upper edge of the glenoid cavity.

Ins. Back part of the tubercle of the radius.

Use. To flex the forearm, make tense the fascia, and raise the arm.

Brachialis anticus. *Or.* Centre of the humerus by two slips on either side of the insertion of the deltoid, and from the fore part of the humerus to its condyles.

Ins. Coronoid process of the ulna and the rough surface beneath that process.

Use. To flex the forearm towards the humerus.

TRICEPS EXTENSOR CUBITI. *Or.* *Long* or *middle* head, from the lower part of the neck of the scapula and anterior portion of the inferior costa. *External*, or *second* head, from a ridge on the humerus, below the insertion of the teres minor. *Short* or *third* head, from a ridge below the insertion of the teres major, leading to the internal condyle, and from the internal intermuscular ligament.

Ins. Olecranon process of the ulna, and the fascia of the forearm.

Use. To extend the forearm, and carry the arm somewhat backwards.

Forearm and Hand.

PRONATOR RADII TERES. *Or.* Anterior part of the internal condyle, fascia of the forearm, intermuscular septa, and the coronoid process of the ulna.

Ins. Outer and back part of the radius, about its centre.

Use. To pronate the hand, and to assist in the flexion of the forearm.

FLEXOR CARPI RADIALIS. *Or.* Inner condyle and the intermuscular septa.

Ins. Base of the metacarpal bone of the index-finger.

PALMARIS LONGUS. *Or.* Inner condyle and fascia of the forearm.

Ins. Annular ligament and palmar aponeurosis, near the root of the thumb.

Use. To bend the hand towards the forearm, and make the fascia tense.

FLEXOR CARPI ULNARIS. *Or.* Inner condyle, inner side of the olecranon, inner edge of nearly whole length of the ulna, and the fascia of the forearm.

Ins. Os pisiforme and base of the fifth metacarpal bone.

Use. To flex the hand and adduct it.

FLEXOR DIGITORUM SUBLIMIS PERFORATUS. *Or.* Inner condyle, internal lateral ligament, coronoid process, and the radius below its tubercle.

Ins. Anterior part of the second phalanges of each finger.

Use. To bend the second joints of the fingers on the hand, the hand on the forearm, and this towards the humerus.

FLEXOR DIGITORUM PROFUNDUS PERFORANS. *Or.* Three upper fourths of the anterior surface of the ulna, internal half of interosseous ligament, sometimes from the radius below its tubercle.

Ins. Last phalanx of each finger.

Use. To flex the last phalanx, and to assist the former.

FLEXOR POLLICIS LONGUS. *Or.* Fore part of the radius below the tubercle, and from the interosseous membrane to within two inches of the carpus, sometimes from coronoid process.

Ins. Last phalanx of the thumb.

Use. To bend the phalanges of the thumb upon the hand, and the hand upon the forearm.

PRONATOR QUADRATUS. *Or.* Inferior fifth of the anterior surface of the ulna.

Ins. Anterior part of the inferior fourth of the radius.

Use. To pronate the hand.

SUPINATOR RADII LONGUS. *Or.* External ridge of the humerus to within two inches of the outer condyle, and from the intermuscular ligament.

Ins. Rough surface on the outside of the radius, near its styloid process.

Use. To supine the hand and flex the forearm on the arm.

EXTENSOR CARPI RADIALIS LONGIOR. *Or.* Ridge of the humerus, between the supinator longus and the external condyle.

Ins. Back part of the carpal extremity of the metacarpal bone of the index-finger.

Use. To bend the hand backwards and adduct it somewhat.

EXTENSOR CARPI RADIALIS BREVIOR. *Or.* Inferior and posterior part of the external condyle and the external lateral ligament.

Ins. Carpal extremity of the third metacarpal bone.

Use. Like the last.

EXTENSOR DIGITORUM COMMUNIS. *Or.* External condyle, fascia of the forearm and its intermuscular septa, and from the ulna.

Ins. Posterior aspect of all the phalanges of four fingers.

Use. To bend the fingers backwards.

EXTENSOR CARPI ULNARIS. *Or.* External condyle, fascia, and intermuscular septa, and from ulna.

Ins. Carpal end of the fifth metacarpal bone.

Use. To bend the hand backwards and adduct it.

ANCONÆUS. *Or.* Posterior and inferior part of external condyle and lateral ligament.

Ins. External surface of the olecranon, and superior fifth of the posterior surface of the ulna.

Use. To extend the forearm, and raise the synovial membrane out of the elbow-joint.

EXTENSOR MINIMI DIGITI. *Or.* In common with the former.

Ins. Posterior part of phalanges of the little finger, in common with the fourth tendon of the extensor communis.

Use. To assist the common extensor.

SUPINATOR RADII BREVIS. *Or.* External condyle, external lateral, and coronary ligaments, and from a ridge on the outer side of the ulna, which commences below its lesser sigmoid cavity.

Ins. Upper third of the external and anterior surface of the radius, from above its tubercle to the insertion of the pronator radii teres.

Use. To supine the hand by turning the radius outwards.

EXTENSOR OSSIS METACARPI POLLICIS. *Or.* Middle of the posterior part of ulna, below the anconæus, interosseous ligament, and posterior surface of the radius.

Ins. Os trapezium and upper and back part of metacarpal bone of the thumb.

Use. To extend the first joint of the thumb, abduct it, extend the wrist, and assist in supination.

EXTENSOR PRIMI INTERNODII POLLICIS. *Or.* Back part of the ulna, below its middle, the interosseous ligament, and the radius.

Ins. Posterior part of the first phalanx, and often the second.

Use. To extend the second joint of the thumb, and cooperate with the former.

Extensor secundi internodii pollicis. *Or.* Posterior surface of the ulna, above its centre, and from the interosseous ligament.
Ins. Posterior part of the last phalanx.
Use. To extend the third joint and assist the former.

Extensor indicis. *Or.* Middle of the posterior surface of the ulna and the interosseous ligament.
Ins. Second and third phalanges.
Use. To extend the forefinger, as when it points to an object.

PROPER MUSCLES OF THE HAND.

Palmaris brevis. *Or.* Annular ligament and the palmar fascia.
Ins. Integuments on the inner side of the palm.
Use. To make the palm hollow, by drawing the skin towards the thumb.

Abductor pollicis. *Or.* Anterior aspect of annular ligament, os naviculare, and trapezium.
Ins. Outside of the base of the first phalanx, and by an expansion into both phalanges.
Use. The use of this, as of most of the other muscles, is sufficiently explained by their names.

Opponens pollicis. *Or.* Annular ligament and the os naviculare.
Ins. Anterior extremity of the metacarpal bone of the thumb.

Flexor pollicis brevis. *Or.* External head, from the inside of the annular ligament and trapezium and scaphoid bones.
Ins. External sesamoid bone and base of the first phalanx of the thumb. Internal head. *Or.* From os magnum and the base of the metacarpal bone of the middle finger.
Ins. Internal sesamoid bone and the base of the first phalanx.

Adductor pollicis. *Or.* Three fourths of the anterior surface of the third metacarpal bone.
Ins. Inner side of the root of the first phalanx of the thumb.

Abductor indicis. *Or.* Metacarpal bone of the forefinger and one half of that of thumb.
Ins. Outer side of the base of the first phalanx.

Lumbricales. *Or.* Outer side of the tendons of the flexor profundus, near the carpus, a little beyond the annular ligament.
Ins. Middle of the first phalanx and the tendinous expansion covering the back of each finger.
Use. To bend the first joint of the fingers, to adduct and abduct them, and may, when the extensors are in action, assist them.

ABDUCTOR MINIMI DIGITI. *Or.* Annular ligament and os pisiforme.

Ins. Ulnar side of the first phalanx.

FLEXOR BREVIS MINIMI DIGITI. *Or.* Annular ligament and the unciform bone.

Ins. Base of the first phalanx of the little finger.

ADDUCTOR MINIMI DIGITI. *Or.* Internal to last, and overlapped by it.

Ins. All the metacarpal bone of the little finger.

INTEROSSEI ANTICI, *vel* INTERNI, *vel* PALMARES. *Or.* Sides of the metacarpal bones.

Ins. First phalanges and tendinous expansion, covering the dorsum of each finger.

1st. *Vel* PRIOR, *vel* EXTERNUS INDICIS. *Or.* Radial side of the second metacarpal bone.

Ins. Radial side of the first phalanx of the forefinger.

Use. To abduct the forefinger.

2d. *Vel* POSTERIOR, *vel* INTERNUS, *vel* ADDUCTOR INDICIS. *Or.* Ulnar side of the second metacarpal bone.

Ins. Inner side of the first phalanx of the forefinger.

Use. To adduct the forefinger.

3d. *Vel* PRIOR, *vel* EXTERNUS, *vel* ADDUCTOR ANNULARIS. *Or.* Radial side of fourth metacarpal bone.

Ins. Radial side of the first phalanx of the ring-finger.

Use. To draw the ring-finger towards the middle one.

4th. *Vel* ADDUCTOR MINIMI DIGITI. *Or.* Radial side of the fifth metacarpal bone.

Ins. Radial of the first phalanx of the little finger.

Use. To draw the little towards the ring-finger.

INTEROSSEI POSTERIORES. *Or.* Opposed sides of two metacarpal bones.

Ins. Base of the first phalanx of the fingers and posterior tendinous expansion.

1st. PRIOR, *vel* EXTERNUS MEDII. *Or.* Second and third metacarpal bones.

Ins. Radial side of the base of the first phalanx of the middle finger.

Use. To draw this finger towards the thumb.

2d. *Vel* INTERNUS MEDII. *Or.* Between the metacarpal bones of the middle and ring fingers.

Ins. Ulnar side of the first phalanx of the middle finger.

Use. To draw this finger towards the ring-finger.

3d. *Vel* EXTERNUS ANNULARIS. *Or.* Between fourth and fifth metacarpal bones.

Ins. Ulnar side of the ring-finger.

Use. To draw the ring towards the little finger.

MUSCLES OF THE ABDOMEN.

The abdominal muscles consist of five pair, viz. obliqui externi, obliqui interni, transversales, recti, and pyramidales: the last are sometimes absent.

Obliquus externus *vel* descendens. *Or.* External surfaces of the eight or nine inferior ribs at a little distance from their cartilages.

Ins. Ensiform cartilage, linea alba, os pubis, Poupart's ligament, into the anterior superior spinous process of the ilium, and the outer edge of two anterior thirds of the crista ilii.

Use. To depress the ribs, compress the abdomen, turn the body to one side, or conjointly, to bend it forwards.

Obliquus internus *vel* ascendens. *Or.* Fascia lumborum, nearly all the crista ilii, and the external third or fourth of Poupart's ligament.

Ins. Cartilages of six inferior ribs, ensiform cartilage, the linea alba, also by the conjoined tendons into the symphysis and upper edge of pubis, and into the linea ileo pectinea.

Use. Its action is like that of the former, each separately may rotate the trunk, cooperating with the opposite external oblique.

Cremaster. This muscle, deriving part of its origin from the internal oblique, is here described, though being a muscle of the testicle. *Or.* Inner surface of the external third of Poupart's ligament, and from the lower edge of the obliquus internus, and sometimes from the transversalis. It often has an attachment to the pubis.

Ins. Tunica vaginalis and scrotum.

Use. To elevate, support, and compress the testicle.

Transversalis. *Or.* Fascia lumborum, posterior part of the crista ilii, the iliac third of Poupart's ligament, and the inner side of the six or seven inferior ribs.

Ins. Along with the posterior lamina of obliquus internus, into the whole length of the linea alba, the upper edge of the pubis, and the linea innominata.

Use. To compress the abdomen, and assist in respiration.

Rectus. *Or.* Upper and anterior part of pubis.

Ins. Ensiform cartilage, the costo-xiphoid ligament, and the cartilages of the sixth and seventh ribs.

Use. To compress the abdomen, to depress the chest towards the pelvis, or raise the latter towards the chest.

Pyramidalis. *Or.* Broad from the pubis.

Ins. Linea alba, midway to umbilicus: it is sometimes wanting.

Use. To make tense the linea alba.

DEEP MUSCLES OF THE ABDOMEN.

The DIAPHRAGM is divided into two portions, a superior broad or true diaphragm, and an inferior lesser portion named crura.

TRUE DIAPHRAGM. *Or.* Posterior surface of the xiphoid cartilage, internal surfaces of the cartilages of the last true and all the false ribs, the external or false ligamentum arcuatum, and the convex edge of the true ligamentum arcuatum.

Ins. Cordiform tendon.

FALSE, OR LESSER DIAPHRAGM, OR CRURA. *Or.* Right crus, from the fore part of the bodies of four superior lumbar vertebræ, the left crus from the sides of the two or three superior lumbar vertebræ.

Ins. Posterior border of the cordiform tendon.

Use of the Diaphragm. To aid in inspiration, and to assist the expulsion of the fœtus, fæces, and urine, vomiting, and many other actions connected with the respiratory organs.

QUADRATUS LUMBORUM. *Or.* Posterior fourth of the crista of the ilium, and from the ilio-lumbar ligament.

Ins. Extremity of the transverse processes of the four superior lumbar and last dorsal vertebræ, also the inner surface of the posterior half of the last rib.

Use. To bend the spine laterally, depress the lowest rib, and support the spine.

PSOAS PARVUS. *Or.* Side of the last dorsal and first lumbar vertebræ.

Ins. Linea ileo-pectinea, fascia iliaca, and fascia lata, behind the femoral vessels: sometimes wanting.

Use. To bend the body forwards, and make tense the crural arch.

PSOAS MAGNUS. *Or.* Sides of the bodies of two last dorsal, and from the bodies and transverse processes of all the lumbar vertebræ, also from the intervertebral ligaments.

Ins. Inferior part of the lesser trochanter and the ridge below that process.

Use. To bend the body forwards, or to bend the thigh upon the body, and rotate the thigh outwards.

ILIACUS INTERNUS. *Or.* Transverse process of the last lumbar vertebra, inner margin of three anterior fourths of the crista ilii, and its two anterior spinous processes and intervening notch, the brim of the acetabulum, the capsular ligament, iliac fossa, and iliac fascia.

Ins. Into psoas magnus; the inferior fibres are inserted into the anterior and inner surface of the femur, below the trochanter minor.

Use. To cooperate with the former, strengthen the capsular ligament, and draw it forwards, from between the neck of the femur and the edge of the acetabulum.

MUSCLES OF MALE PERINÆUM.

SPHINCTER ANI. *Or.* Ano-coccygeal ligament.

Ins. Into the raphe, superficial fascia, and common central point of the perinæum.

Use. To close the anus and depress the bulb of the urethra.

SPHINCTER INTERNUS encircles the lower part of rectum, merely to close the anus.

ERECTOR PENIS. *Or.* Inner surface of the tuber ischii, and from the insertion of the great or inferior sciatic ligament.

Ins. Fibrous membrane of the crus penis.

Use. To draw the penis down and compress its veins, so as to produce the enlargement.

ACCELERATOR URINÆ. *Or.* 1, Triangular ligament of the urethra; 2, by a broad tendon common to both opposite muscles, and which lies above the urethra, between it and pubis; 3, more anteriorly, by a tendinous expansion from the side of corpus cavernosum penis.

Ins. Middle tendinous line or raphe of the perinæum.

Use. To expel the semen and urine, and distend the corpus spongiosum, by forcing the blood into its cells.

TRANSVERSALIS PERINÆI. *Or.* Inside of the tuber ischii.

Ins. Central point of the perinæum.

Use. To support the centre of the perinæum.

LEVATOR ANI. *Or.* Posterior part of the symphysis pubis, obturator fascia, the ilium above the thyroid foramen, the inner surface of the ischium, and its spinous process.

Ins. Anterior or pubic fibres into the central point of the perinæum and fore part of the rectum; middle fibres into the side of the rectum; the posterior fibres into the back part of the rectum, to the os coccygis, and into the last bones of the sacrum.

Use. To raise the rectum in opposition to the inspiratory muscles; to close the rectum, and to compress the vesicula seminales and prostrate gland; to raise the perinæum and compress the membranous portion of the urethra.

COMPRESSOR URETHRÆ. *Or.* By a tendon from the inside of the symphysis pubis.

Ins. Below the membranous portion of the urethra, into the narrow tendinous line, which becomes lost in the central point of the perinæum.

Use. To compress or raise the membranous portion of the urethra. The muscles of the two sides are also named *Wilson's* muscles.

COCCYGEUS. *Or.* Inner surface of the spine of the ischium.

Ins. Extremity of the sacrum and side of the coccyx.

Use. To support the coccyx.

MUSCLES OF FEMALE PERINÆUM.

Sphincter ani. *Or.* Ano-coccygeal ligament.

Ins. Raphe, superficial fascia, and common central point of the perinæum.

Use. To close the anus.

Levator ani. *Or.* Posterior part of the symphysis pubis, below the true ligaments of the bladder, obturator fascia, ilium above the thyroid foramen, the inner surface, and spine of ischium.

Ins. The same as in the male.

Use. To raise the anus and compress the vagina.

Coccygeus, as in the male.

Transversalis perinæi, as in the male.

Erector clitoridis. *Or.* Inner surface of the tuber ischii, and insertion of the great sciatic ligament.

Ins. Fibrous membrane of the crus clitoridis.

Use. Of the same as the erector penis of the male.

Sphincter vaginæ extends from the clitoris superiorly, around each side of the vagina to the central point of the perinæum, in front of the anus.

Use, as its name implies.

MUSCLES OF THE INFERIOR EXTREMITY

Are classed into those of the thigh, leg, and foot.

Muscles on the Fore Part and Sides of the Thigh.

Tensor vaginæ femoris. *Or.* External part of the anterior superior spinous process of the ilium.

Ins. Duplicature of fascia lata, on the outer side of the thigh, about three inches below the great trochanter.

Use. To make tense the fascia of the thigh, and to rotate the thigh inwards, to flex and abduct it.

Sartorius. *Or.* Anterior superior spine of the ilium and the notch beneath it.

Ins. Inner side of the upper end of the tibia, below its tubercle.

Use. To bend the leg on the thigh and the thigh on the pelvis, to adduct the thigh and throw it over the opposite one, to advance the leg and turn it outwards, and when the leg is bent it may turn it inwards, and in standing supports the pelvis.

Rectus femoris. *Or.* Anterior inferior spinous process of the ilium, the acetabulum, and capsular ligament.

Ins. Upper edge of the patella and its ligament.

Use. To extend the leg, flex the thigh on the pelvis, support the pelvis, and strengthen the capsular ligament.

VASTUS EXTERNUS. *Or.* Root and anterior part of the great trochanter, the outer edge of the linea aspera, the oblique ridge leading to the external condyle, all the external surface of the femur, and the fascia lata.

Ins. External surface of the tendon of the rectus, the side of the patella, and the head of the tibia.

Use. To extend the leg and rotate it outwards.

VASTUS INTERNUS. *Or.* Anterior part of the femur, linea inter-trochanterica, the inner edge of the linea aspera, and inside of the femur.

Ins. Inner edge of the tendon of the rectus, the patella, and head of the tibia.

Use. To extend the leg and turn it inwards.

CRURÆUS. *Or.* Anterior and external part of the femur, commencing at the linea inter-trochanterica, and extending along three fourths of the bone, as far outwards as the linea aspera.

Ins. Upper and outer edge of the patella, and the synovial membrane of the knee-joint.

Use. To extend the leg, assisting the three former.

SUBCRURÆUS, OR CAPSULARIS. *Or.* Inferior fourth of the anterior surface of the femur.

Ins. Synovial membrane of the knee-joint.

Use. To raise the synovial membrane.

GRACILIS. *Or.* Lower half of the symphysis, and inner edge of the descending ramus of the os pubis.

Ins. Superior part of the internal surface of the tibia.

Use. To adduct the thigh and leg, and bend the knee.

PECTINÆUS. *Or.* Linea innominata on the horizontal ramus of the pubis.

Ins. Rough edge leading from the lesser trochanter to the linea aspera.

Use. To adduct the thigh, rotate it outwards, and flex it, and strengthen the hip-joint.

TRICEPS ADDUCTOR FEMORIS consists of three portions :

1st, ADDUCTOR LONGUS. *Or.* Anterior surface of the pubis, between the spine and symphysis.

Ins. Middle third of the linea aspera.

Use. To adduct the thigh, rotate it outwards, support the pelvis ; the long and short portions can flex the thigh on the pelvis, the great portion may extend it.

2d. ADDUCTOR BREVIS. *Or.* Anterior inferior surface of the pubis, between its symphysis and the thyroid foramen.

Ins. Superior third of the internal root of linea aspera to three inches below the lesser trochanter.

3d. ADDUCTOR MAGNUS. *Or.* Anterior surface of the descending ramus of the pubis, ramus of the ischium, and the external border of its tuberosity.

Ins. Rough ridge leading from the great trochanter to the linea aspera, the linea aspera, and internal condyle of the femur.

MUSCLES OF THE HIP.

Glutæus maximus. *Or.* Posterior fifth of crista ilii, the rough surface between it and the superior semicircular ridge, the posterior ilio-sacral ligaments, the lumbar fascia, the spines of the sacrum, the side of coccyx, and the great sciatic ligament.

Ins. Rough ridge leading from the great trochanter to linea aspera, and upper third of linea aspera.

Use. To extend the thigh, rotate it outwards, abduct it, and support the pelvis and trunk on the lower extremity.

Glutæus medius. *Or.* Deep surface of the fascia covering it, the three anterior fourths of crista ilii, the superior semicircular ridge, and surface of the ilium above and below it.

Ins. Upper and outer part of the great trochanter.

Use. To extend the thigh by its posterior fibres, rotate it outwards, adduct, and by its anterior fibres rotate it inwards, and support the pelvis on the thigh.

Glutæus minimus. *Or.* Inferior semicircular ridge on the dorsum of the ilium, the rough surface between it and the edge of the acetabulum.

Ins. Upper and anterior part of the great trochanter.

Use. Similar to the former, but in addition gives immediate protection to the hip-joint.

Pyriformis. *Or.* Concave surfaces of the 2d, 3d, and 4th divisions of the sacrum, the upper and back part of the ilium, and the anterior surface of the great sciatic ligament.

Ins. Upper part of the digital fossa at the root of the great trochanter.

Use. To rotate the thigh outwards, and abduct it.

Gemellus superior. *Or.* Spine of the ischium.

Ins. Upper part of the digital fossa.

Use. To rotate the thigh outwards, and abduct it.

Gemellus inferior. *Or.* Upper part of the tuber ischii, and the great sciatic ligament.

Ins. Digital fossa, with the gemellus superior.

Use. Like the former.

Obturator internus. *Or.* Pelvic surface of the obturator ligament, circumference of the obturator foramen, except at the notch for the vessels, where it arises from the ligamentous arch, the pubis internally, the ischium inferiorly, and the obturator fascia.

Ins. Digital fossa.

Use. Like the gemelli.

Quadratus femoris. *Or.* External surface of the tuber ischii.

Ins. Inferior and posterior part of the great trochanter and posterior linea inter-trochanterica.

Use. To rotate the thigh outwards, and slightly to adduct it.

Obturator externus. *Or.* Inferior surface of the obturator ligament and surrounding surfaces of the pubis and ischium.

Ins. Digital fossa.

Use. Like the former.

MUSCLES OF THE BACK PART OF THE THIGH.

Biceps flexor cruris. *Long head.* *Or.* Outer and back part of the tuber ischii. *Short head.* *Or.* Linea aspera, from below the insertion of the glutæus maximus to within two inches of the external condyle.

Ins. Head of the fibula.

Use. To flex the leg on the thigh, extend the thigh, fix the pelvis, and rotate the limb outwards.

Semitendinosus. *Or.* Tuberosity of the ischium, with the long head of the biceps, and from three inches of its tendon.

Ins. Anterior angle of the tibia, below the tubercle.

Use. To flex the leg and rotate it inwards, and to support the pelvis.

Semimembranosus. *Or.* Upper and outer part of tuber ischii.

Ins. 1st, into external condyle of the femur, forming the ligament of Winslow; 2d, into the posterior heads of tibia and fibula; 3d, into the head of tibia.

Use. Like the former, and to strengthen the posterior part of the knee-joint.

MUSCLES ON THE ANTERIOR AND EXTERNAL PART OF THE LEG.

Tibialis anticus. *Or.* Outer part of the two superior thirds of the tibia, head of the fibula, the inner half of the interosseous ligament, fascia of the leg, and the intermuscular septa.

Ins. Inner side of the internal cuneiform bone and base of the first metatarsal bone.

Use. To adduct the foot, turn the toes inwards, and support the leg.

Extensor digitorum longus. *Or.* External part of the head of the tibia, head of the fibula, and three fourths of this bone, part of the interosseous ligament, fascia of the leg and intermuscular septa.

Ins. Last phalanx of the four external toes.

Use. To extend the toes and flex the ankle.

Extensor pollicis proprius. *Or.* Inner edge of the middle third of the fibula, the interosseous ligament, and lower part of the tibia.

Ins. By two tendinous fasciculi, one into the base of the first, the other into the base of the second phalanx of the great toe.

Use. To extend the great toe, bend the ankle, and rotate the foot inwards.

Peronæus tertius. *Or.* Anterior surface of the lower half of the fibula.

Ins. Base of the fifth metatarsal bone, and fibres to join the fourth tendon of the extensor communis.

Use. To extend the little toe, bend the ankle, abduct the foot, and raise its outer edge.

Extensor digitorum brevis. *Or.* Upper and anterior part of the os calcis, the cuboid bone, the astragalus, and annular ligament.

Ins. Internal tendon into the base of the first phalanx of the great toe, the three others join the outer edges of corresponding tendons of the extensor digitorum longus.

Use. To extend these toes and turn them outwards.

MUSCLES ON THE OUTER PART OF THE LEG.

Peronæus longus. *Or.* Around the head of the fibula, adjacent surface of tibia, the upper half of the external angle of the fibula, the fascia, and intermuscular septa.

Ins. Outer side of the metatarsal bone of the great toe, and adjacent sesamoid bone, also into the internal cuneiform bone and base of the second metatarsal bone.

Use. To extend the ankle, to turn the foot outwards, and elevate its external edge.

Peronæus brevis. *Or.* Outer and back part of the lower half of the fibula, and the intermuscular septa.

Ins. Os cuboides and base of the metatarsal bone of the little toe.

Use. Like the former.

MUSCLES OF THE BACK OF THE LEG

Consist of a superficial and deep layer.

Superficial Layer.

Gastrocnemius. *Or. Internal head:* upper and back part of the internal condyle of the femur, and the oblique ridge above it. *External head:* from above the external condyle.

Ins. Lower and back part of the os calcis.

Use. To raise the heel and extend the ankle, to flex the knee-joint and strengthen it.

Plantaris. *Or.* Back part of the femur above the external condyle, and posterior ligament of the knee.

Ins. Posterior part of the os calcis, anterior to the tendo Achillis; sometimes wanting.

Use. To extend the foot, stretch the fascia, and bend the knee.

Solæus. *Or.* *External head:* from the back part of the head and superior third of the fibula. *Internal head:* from the middle third of the tibia: it unites with gastrocnemius to form the tendo Achillis.

Ins. Lower and back part of the os calcis.

Use. To assist the gastrocnemius.

Deep Layer.

Poplitæus. *Or.* Depression on the outer condyle of the femur.

Ins. Flat triangular surface, occupying the superior posterior fifth of the tibia.

Use. To flex the knee.

Flexor digitorum perforans. *Or.* Posterior flat surface of the tibia, from below the poplitæus to within three inches of the ankle, the fascia, and intermuscular septa.

Ins. Last phalanx of four lesser toes.

Use. To flex the toes and metatarsus, and extend the ankle.

Tibialis posticus. *Or.* Posterior internal part of the fibula, upper part of the tibia, and nearly the whole length of the interosseous ligament.

Ins. Inferior and internal tuberosity on the os naviculare, the internal cuneiform and cuboid bones, and the second and third metatarsal bones.

Use. To extend the ankle and elevate the inner edge of the foot.

Flexor pollicis longus. *Or.* Two inferior thirds of the fibula.

Ins. Last phalanx of the great toe.

Use. To bend this toe, to extend the ankle, and adduct the foot.

MUSCLES OF THE FOOT

Are divided into four layers.

First Layer.

Abductor pollicis. *Or.* Lower and inner part of the os calcis, the internal annular ligament, plantar aponeurosis, and the internal intermuscular septum.

Ins. Internal sesamoid bone, and internal side of base of the first phalanx of the great toe.

Use. To separate the great toe from the rest.

Flexor digitorum brevis perforatus. *Or.* Inferior and internal part of the os calcis, internal annular ligament, plantar aponeurosis, and intermuscular septa.

Ins. Second phalanx of the four lesser toes.

Use. To assist the long flexor.

Abductor minimi digiti. *Or.* Outer side of the os calcis, ligament extending from the os calcis to the outer side of the fifth metatarsal bone, the plantar fascia, the external intermuscular septum, and the base of the fifth metatarsal bone.

Ins. Outer side of the base of the first phalanx of the little toe.

Use. To separate the little toe from the rest, and to flex it.

Second Layer.

Musculus accessorius. *Or.* Inferior and internal part of the os calcis.

Ins. Outer part of the tendon of the flexor digitorum longus, before it divides.

Use. To strengthen the long flexor, and obviate its obliquity.

Lumbricales, four in number. *Or.* Tendons of the flexor digitorum longus.

Ins. Internal side of the first phalanx of the four lesser toes.

Use. To adduct and flex these toes.

Third Layer.

Flexor pollicis brevis. *Or.* Lower and anterior part of the os calcis and external cuneiform bone.

Ins. Sesamoid bones, beneath the first phalanx of the great toe.

Use. To flex the first joint of this toe, and bring it close to the others.

Adductor pollicis. *Or.* Calceo-cuboid ligament and base of the second and third metatarsal bones.

Ins. External sesamoid bone, with the flexor pollicis brevis.

Use. To approximate the great to the other toes, and slightly flex it beneath them.

Transversalis pedis. *Or.* Anterior extremities of the four external metatarsal bones.

Ins. External sesamoid bone of the great toe.

Use. To approximate the toes, and strengthen the arch of the foot.

Flexor brevis minimi digiti. *Or.* Cuboid and fifth metatarsal bones, and sheath of the tendon of the peronæus longus.

Ins. Inner side of the base of the first phalanx of the little toe.

Use. To flex and adduct the little toe.

Fourth Layer.

Seven interossei muscles. Three are seen on the sole of the foot, and four upon its dorsum.

Inferiores, *vel* interossei interni.

1st. Adductor medii digiti, situated between the second and third metatarsal bones. *Or.* Inner side of the third metatarsal bone.

Ins. Base of the first phalanx of the third toe.

2d. Adductor quarti digiti. *Or.* Inner side of the fourth metatarsal bone.

Ins. Inner side of the first phalanx of the fourth toe.

3d. Adductor minimi digiti. *Or.* Fifth metatarsal bone.

Ins. Inner side of the base of the first phalanx of the little toe.
Use. Their names express their uses.

SUPERIORES, *vel* INTEROSSEI EXTERNI, are bicipital muscles.

1st. *Or.* Internal side of the second metatarsal bone and outer side of the first.
Ins. Inner side of the base of the first phalanx of the second toe.
Use. To approximate the second to the great toe.

2d. *Or.* Opposite sides of the second and third metatarsal bones.
Ins. Outer side of the first phalanx of the second toe.
Use. To separate the second from the great toe.

3d. Opposite sides of the third and fourth metatarsal bones.
Ins. Outer side of the first phalanx of the middle toe.
Use. To remove the third from the two inner toes.

4th. Opposite sides of the fourth and fifth metatarsal bones.
Ins. Outer side of the first phalanx of the fourth toe.
Use. To separate the fourth from the three inner toes.

MUSCLES OF THE ORBIT

Are seven in number.

1st. LEVATOR PALPEBRÆ SUPERIORIS. *Or.* Upper edge of the foramen opticum.
Ins. Superior border of the tarsal cartilage.

2d. OBLIQUUS SUPERIOR. *Or.* Margin of foramen opticum.
Ins. Sclerotic coat between the superior and external rectus.
Use. To rotate the eye downwards and inwards, towards the nose.

3d. OBLIQUUS INFERIOR. *Or.* Orbital edge of the superior maxillary bone.
Ins. Sclerotic coat between it and the external rectus muscle, behind the transverse axis of the eye.
Use. To rotate the globe of the eye, upwards and outwards.

4th. RECTUS SUPERIOR, *vel* ATTOLLENS OCULI.

5th. RECTUS INFERIOR, *vel* DEPRESSOR OCULI.

6th. RECTUS INTERNUS, *vel* ADDUCTOR OCULI.

7th. RECTUS EXTERNUS, *vel* ABDUCTOR OCULI.

[All arise round the optic foramen, the external rectus being also attached to the margin of the sphenoidal fissure, and they are inserted about a quarter of an inch behind the cornea, and their names express their use.]

CLASSIFICATION
OF
MUSCLES OF SOME PARTICULAR PARTS.

Lower Jaw.

Elevators.

Temporalis.
Masseter.
Internal pterygoid.

Depressors.

Platysma myoides.
Digastricus.
Mylo-hyoideus.
Genio-hyoideus.
.... hyo-glossus.

Lateral Rotators.

Pteryoideus externus.
.... internus.

Os Hyoides.

Elevators.

Digastricus.
Stylo-hyoideus.
Mylo ....
Genio ....
Genio-hyo-glossus.

Depressors.

Sterno-hyoideus.
.... thyroideus.
Thyro-hyoideus.
Omo-hyoideus.

Larynx.

Dilators.

Crico-arytænoideus posticus.
.... thyroideus.

Contractors.

Arytænoideus.
Crico-arytænoideus lateralis.
Thyro-arytænoideus.

Shoulder-joint, or Humerus.

Elevators.

Deltoides.
Pectoralis major (partly).
Supraspinatus.
Coraco-brachialis.
Biceps (long head).

Depressors.

Pectoralis major.
Latissimus dorsi.
Teres major.
Subscapularis.
Triceps (long head).

Adductors.

Pectoralis major.
Deltoides (anterior part).
Biceps.
Coraco-brachialis.

Abductors.

Deltoides (posterior part).
Latissimus dorsi.
Teres major.
.... minor.
Triceps (long head).

Rotators, inwards.

Deltoides (anterior part).
Pectoralis major.
Subscapularis.
Latissimus dorsi.
Teres major.

Rotators, outwards.

Deltoides (posterior part).
Supraspinatus.
Infraspinatus.
Teres minor.
Coraco-brachialis.

ELBOW-JOINT.

Flexors.

Biceps.
Brachialis anticus.

Extensors.

Triceps.
Anconæus.

HIP-JOINT.

Flexors.

Iliacus.
Psoas magnus.
Pectinæus.
Triceps (long and short head).
Tensor vaginæ femoris.
Sartorius.
Rectus.
Glutæus medius. } anterior portion.
.... minimus. }

Extensors.

Glutæus maximus.
.... medius.
.... minimus.
Adductor magnus (posterior portion).
Pyriformis.
Semimembranosus.
Semitendinosus.
Biceps (long head).

Adductors.

Triceps.
Pectinæus.
Gracilis.
Iliacus.
Psoas magnus.
Sartorius.
Obturator externus.
Quadratus.

Abductors.

Glutæi.
Tensor vaginæ femoris.
Obturator internus.
Gemelli.
Pyriformis.

Rotators, outwards.

Iliacus.
Psoas magnus.
Pectinæus.
Triceps.
Glutæus maximus.
Glutæus medius. } posterior portion.
.... minimus. }
Pyriformis.
Gemelli.
Obturatores.
Quadratus femoris.

Rotators, inwards.

Tensor vaginæ femoris.
Glutæus medius. } anterior portion.
.... minimus. }

When the Leg is extended.

Sartorius.
Gracilis.
Semitendinosus.

LEG OR KNEE-JOINT.

Flexors.

Biceps.
Semitendinosus.
Semimembranosus.
Gracilis.
Sartorius.
Popliteus.

Extensors.

Rectus.
Vastus externus.
.... internus.
Cruræus.

FOOT.

Flexors,

Which bring the foot towards the front of the leg.

Tibialis anticus.
Extensor communis digitorum.
.... proprius pollicis.
Peronæus tertius.

Extensors.

Gastrocnemius.
Solæus.
Plantaris.
Flexor longus digitorum.
.... pollicis.
Tibialis posticus.
Peronæus longus.
.... brevis.

Adductors,

Inclining the foot inwards.

Extensor proprius pollicis.
Flexor longus ....
.... digitorum.
Tibialis posticus.

Abductors.

Peronæus longus.
.... brevis.
.... tertius.
Extensor longus digitorum.

THE BRAIN AND NERVOUS SYSTEM.

The contents of the cranial cavity are, the *brain*, with its *vessels*, *membranes*, and *nerves*.

The membranes are three in number: the *dura mater*, *tunica arachnoidea*, and *pia mater*.

The *dura mater* is a very strong, dense, fibrous membrane, of a white pearly appearance, rough externally, smooth internally. It lines the cranium, and forms its internal periosteum; it also extends down the spinal column in the form of a sheath to the spinal cord, but does not become the periosteum as in the cranium, being separated from the bones by veins, serous fluid, and cellular tissue.

Its fibres run in different directions: those on the outside are longitudinal, those on the inside circular; and, besides these, there are oblique fibres, which take various courses.

The outer surface is rendered rough by a separation of he vessels, which pass from the membrane to the bones or their nutrition. On the outer surface of this membrane, near the mesial line of the vertex, are seen some granular bodies, called the external Pacchionian glands: heir use is not known.

The inner surface is smooth, and united firmly to a layer of the arachnoid membrane, which indeed may be said to produce the polished smooth appearance.

The arteries of the dura mater, named meningeal, are anteriorly from the ophthalmic; in the centre, from the internal maxillary; and posteriorly, from the vertebral, occipital, and ascending pharyngeal.

Its veins empty themselves into the neighbouring sinuses. The dura mater serves as a channel for the passage of the nerves from the cranium, and gives an investment to many of them at their exit.

It is divisible into two layers, of which the external one is the thickest. By their separation in certain parts spaces are left, called sinuses; and by a folding of the internal portion, are formed the falx major, falx minor, and tentorium.

The *falx cerebri*, or *major*, extends from the crista galli, following the course of the sagittal suture, to the internal occipital protuberance at the back part of the skull, where it unites with the tentorium. It divides the cerebrum into two portions, called hemispheres. It protects either hemisphere from the pressure of the other, in lateral positions of the head.

The *tentorium* extends across the back part of the cranium, between the cerebrum and the cerebellum, and protects the latter from the pressure of the former.

The *falx cerebelli* extends from the tentorium to the foramen magnum, along the spine of the occipital bone, to the margin of the foramen magnum.

The sinuses in the dura mater, or venous reservoirs of the brain, are the *superior* and *inferior longitudinal;* the *right* and *left lateral;* the *straight sinus;* the *torcular*

Herophili; anterior and *posterior clinoid sinuses*, the *transverse sinus*, and the *circular sinus of Ridley;* and on each side, the *superior* and *inferior petrosal;* the *cavernous* and the *occipital*. They are lined with a delicate membrane of the same character as that of the veins with which they communicate.

The *superior longitudinal* is triangular in shape, commencing at the foramen cæcum, and extending to the torcular Herophili, where it may be said to terminate in the lateral sinuses; within it, we find the middle Pacchionian glands, riband-shaped chordæ Willisii, and the openings of the veins from behind forwards.

The *inferior longitudinal* is in the inferior portion of the falx major; posteriorly it unites with the vena Galeni, and forms the *straight sinus*, which runs along the middle of the tentorium to the torcular Herophili.

The *torcular Herophili* is a conflux of sinuses opposite the centre of the crucial spine, with about six openings in it, viz. one from the superior longitudinal, one from the straight, two into the lateral, and one or two from the occipital sinus or sinuses.

The *lateral sinuses* carry out the blood from the brain, by the foramina lacera posteriora, and in that situation become the internal jugular veins. The right one is generally the larger.

The *transverse sinuses*, or more properly *clinoid*, run along the anterior and posterior walls of the pituitary fossa; and by connecting the two cavernous sinuses, they form, conjointly, the *circular sinus of Ridley*. There s a third (the proper) *transverse* sinus below and behind he posterior clinoid processes, which connects the inferior petrosal sinuses.

The *superior petrosal* is small, and lies upon the superior angle of the petrous bone; it leads from the cavernous and pours its blood into the lateral sinus.

The *inferior petrosal* is a continuation of the cavernous sinus; it rests upon the contiguous borders of the petrous and occipital bone, grooving them, and pours its blood into the lateral sinus.

The *occipital sinuses* are small and irregular, sometimes wanting; they pass from the edge of the foramen magnum, along the attached margin of the falx minor, into the torcular Herophili; sometimes they communicate with the lateral sinuses, near the anterior margin of the foramen magnum.

The *cavernous sinus* of each side is situated on the side of the body of the sphenoid bone. Anteriorly it receives the ophthalmic vein, conveying most of the blood from the orbit; posteriorly it leads to the petrosal sinuses, and internally unites with the clinoid sinuses. It is formed by a separation of the layers of the dura mater; the lower and internal one, resting on the bones, is thin; the upper one is much thicker, and extends from the clinoid processes to the petrous bone; it contains within its fibres or laminæ the third, fourth, and first division of the fifth nerve.

The intermediate space is lined by a delicate membrane, continuous with the inner coat of the ophthalmic vein, and this is reflected over the parts which traverse the sinus, so that they are not in immediate contact with the blood; the parts passing through are the carotid artery, with filaments of nerves, forming the carotic plexus, and, on the outer side of the artery, the sixth pair of nerves. There are, besides, numerous tendinous fibres stretched across, which give it an intricate cellular appearance.

Under the dura mater, and resting on the pia mater, is the *tunica arachnoides.* It is a delicate, smooth, transparent, serous membrane, forming a shut sac, reflected over the cerebral mass, spinal cord, and nerves, as far as their exit from the cranium and spinal sheath, and lining the dura mater.

It is adherent to the pia mater in every part, except between the tuber annulare and conjoint optic nerves, and also between the medulla oblongata and cerebellum, and in the anfractuosities of the brain, where it is covered by the pia mater only. Under the velum it surrounds the vena Galeni, traverses the fissure of Bichat, and passes into the third, and thence into the lateral and fourth ventricles, forming their lining membrane. This is denied by some anatomists, who say that the ventricles are lined by a distinct delicate membrane; and which statement is most probably correct.

Immediately under and closely connected with the arachnoid membrane is the *pia mater.* It appears to be an expansion of cellular tissue, to admit of and conduct the ramifications of the vessels. It immediately covers the brain, and also dips down between the convolutions: processes of it enter the lateral ventricles, forming the choroid plexuses: a continuation of these under the fornix is named tela choroidea, or velum interpositum; there are also little processes of it protruded into the fourth ventricle. It passes down upon the spinal cord, but becomes thicker, more lamellated, and of a paler colour, and less vascular. Cloquet considers that it is not the same membrane, but without sufficient reason. That of the cranium is perfectly continuous with the one upon the spinal cord, and differs, probably, on account of the part to which it is applied. Unlike the arachnoid, it is extended upon the nerves, which quit the cranium and spinal column, and chiefly forms their neurilema.

In addition to the three membranes just described as common to the brain and spinal cord, there is a fourth membranous structure, peculiar to the spinal marrow, viz. the *ligamentum denticulatum*. It is a delicate transparent membrane, presenting a number of triangular portions, placed between the anterior and posterior spinal nerves, attached by their apex to the inner surface of the dura mater, by their base to the pia mater; their use and precise structure are not known. Some consider them to be formed by arachnoid, others that they are of a distinct cellular nature.

CEREBRO-SPINAL SYSTEM.

The cerebro-spinal system is composed of four substances, differing in their colour.

The white or *medullary substance* constitutes the inner part of the cerebrum and cerebellum, but is placed externally in the pons varolii, crura cerebri and cerebelli, the medulla oblongata, and medulla spinalis. It has a fibrous structure, and appears to consist of minute globules united together in a linear manner.

The gray or *cineritious substance*, forms the outer layer of the cerebrum and cerebellum, and is found in the centre of the pons varolii, crura cerebri and cerebelli, the medulla oblongata, and medulla spinalis. Its colour is owing to its numerous minute blood-vessels; its globules are not arranged in lines so as to give the appearance of fibres.

The yellow substance is a modification of the gray, and may be seen between the gray and white in the lower part of the posterior cerebral lobes, and in the cerebellum.

The black substance is seen in the crura cerebri, of a semilunar form, called locus niger.

THE BRAIN.

The brain, as it is ordinarily denominated, consists of the *cerebrum*, *cerebellum*, and *medulla oblongata.*

The *cerebrum* occupies the upper and larger portion of the cranium. It is divided by the falx major into two *hemispheres;* and each hemisphere is divided into three lobes, the anterior, middle, and posterior; the two former are separated, inferiorly, by a depression, named *fissura Sylvii;* between the middle and posterior lobe there is no distinct line of demarcation.

The *anterior* lobe rests on the orbitar plate of the frontal bone, the alæ minores of the sphenoid, and on the ethmoid.

The *middle* lobe rests upon the alæ majores of the sphenoid, and on the temporal bone, parts which form the middle fossa of the cranium.

The *posterior* lobe rests on the tentorium.

On the surface of each hemisphere are seen convex ridges running in various directions, named gyri or convolutions; the fissures between them are named sulci; the surface is adherent to the pia mater by cellular tissue and vessels, to which Ruysch has given the name of *tomentum cerebri.*

On gently separating the hemispheres of the cerebrum superiorly, the *corpus callosum* or commissura magna cerebri is brought into view. It is a white medullary substance, about three inches in length, extending transversely and horizontally from the inside of each hemisphere. Its upper surface is convex; a furrow, called raphè, runs along its centre, on the side of which are elevated ridges, and external to them, transverse lines, named *lineæ transversæ*. The anterior cerebral arteries run upon it, and are here named arteries of the corpus callosum.

The corpus callosum is reflected downwards anteriorly, forming a rounded margin, and extends to the base of the brain, to become continuous with the under surface of the corpus striatum; it passes over the optic commissure, with which it is slightly blended, and is lost in the tuber cinereum and substantia perforata antica; posteriorly it terminates by a defined rounded margin, continuous with the fornix.

After slicing away the substance of either hemisphere to a level with the corpus callosum, a medullary portion is left, of an oval form, called *centrum ovale minus*; the two, similarly sliced off, form the *centrum ovale majus*.

By gently cutting longitudinally into this white substance on each side of the corpus callosum, we make an opening into each lateral ventricle. The *lateral* ventricles are of a very irregular form, and are divided into three cornua and a body.

The *anterior cornu* is the small pointed anterior portion projecting into the anterior lobe, and diverging from the opposite one.

The *posterior cornu* projects into the posterior lobe, elongated, and of the form of a spur, converging at its extremity to the opposite one. The white matter forming its floor is named hippocampus minor.

The *body* of the ventricle presents along its floor, from behind forwards, the corpus striatum tænia semicircularis, choroid plexus, and thalamus opticus.

The descending cornu takes a direction first backwards, outwards, and downwards, afterwards forwards and inwards, towards the base of the brain, at the inner edge of the fissure of Sylvius.

The parts noticed in it are the projecting white matter, named hippocampus major, which, inferiorly, forms four or five eminences, named the pes hippocampi; a thin riband-shaped margin anteriorly, named tænia hippocampi; and parts of the choroid plexus.

The hippocampus major is continuous with the corpus callosum; the tænia hippocampi is a prolongation of the posterior pillars of the fornix. Upon the posterior descending portion of the hippocampus major is a small rounded eminence, named *pes accessorius;* and at the lower part of the tænia hippocampi there is a narrow portion of gray matter, which, from its being notched transversely, produces an appearance which has obtained for it the name of *fascia dentata.*

The *corpora striata* are gray pyriform bodies, with the broad part converging anteriorly; wide apart from each other posteriorly. Internally they consist of a mixture of white and gray matter, so arranged as to have given the name. The white matter is a prolongation of the anterior pyramids, which in this part are supposed to acquire an addition of matter, and these bodies are consequently called ganglia of increase, or superior cerebral ganglia.

Posterior to, and somewhat between the corpora striata, are situated the *thalami optici.* They are white convex bodies, partially connected together internally by some gray matter, named *commissura mollis;* on their posterior surface are two small convex eminences, named *corpus geniculatum internum* and *externum.* They are continuous with the corpora quadrigemina, and from the external one the optic nerve appears to take an origin.

The thin band of white substance seen between the thalamus and corpus striatum is the *tænia semicircularis.* The choroid plexus generally rests upon it.

The lateral ventricles are separated from each other by a thin partition, named *septum lucidum,* attached above to the corpus callosum, and below to the fornix; it is composed of two medullary and two cineritious layers, between which is a cavity named the fifth ventricle. This partition, deep anteriorly, merges to a point posteriorly, where the corpus callosum and fornix unite.

Attached to the inferior edge of the septum lucidum is the fornix. The *fornix* consists of two anterior crura, the body, and the descending or posterior crura. The anterior crura, or pillars, may be traced down to the corpora albicantia. The body of the fornix is somewhat triangular, with the broadest part posteriorly. The posterior crura terminate in or are continuous with the hippocampi majores.

The anterior thin edge of the posterior crura extends into the descending cornu of the lateral ventricles, and is named *corpus fimbriatum,* or *tænia hippocampi.*

The under surface of the body of the fornix is marked with longitudinal lines, forming an appearance called *psalterium* or *lyra.*

There is an opening from each lateral ventricle to the third; it is between the anterior pillars of the fornix and optic thalami, and is named the *foramen of Monro:* through it passes the choroid plexus.

The *choroid plexuses* of the lateral ventricles are vascular, plexiform, membranous bodies, extending from the foramina of Monro over the tænia semicircularis to the lowest part of the ventricles. The veins of each plexus unite and form the *vena Galeni*, which empties itself into the straight sinus. Sometimes there are two venæ Galeni.

Beneath the fornix is situated the *velum interpositum*, or tela choroidea, forming the roof of the third ventricle, extending from the surface of one thalamus opticus to the other, and continuous with the choroid plexuses.

Beneath the velum is situated the *pineal gland*, connected to the thalami by two peduncles; and inferiorly to it, the *corpora quadrigemina*.

The *pineal gland* is a small heart-shaped body, with its base anterior. It rests on the groove between the nates, and is attached by two pillars or peduncles to the thalami optici. It contains a little gritty matter within it, composed of phosphate of lime. It is also named *conarium* and *acervulus cerebri*, and was absurdly imagined by Descartes to be the seat of the soul.

The two highest eminences of the corpora quadrigemina are called *nates*, the posterior inferior are named *testes*. They are connected in front with the thalami, behind to the valve of Vieussens, and processus a cerebello ad testes.

There is a little fissure between their upper surface and the corpus callosum, called the *fissure of Bichat*, which is said by some to admit the passage of the arachnoid membrane into the ventricles.

The *third ventricle* is a deep fissure, bounded laterally by the thalami optici; superiorly, by the velum and fornix; inferiorly, by the pons tarini, corpora albicantia, and tuber cinereum; anteriorly, by the anterior commissure and anterior crura of the fornix; and posteriorly, by the posterior commissure and corpora quadrigemina.

The *anterior commissure* is a medullary band, uniting the corpora striata in front of the anterior crura of the fornix.

The *posterior commissure* is situated at the back part, and under the base of the pineal gland.

The third ventricle receives anteriorly and laterally the foramina of Monro, and to this part the name *foramen commune anterius* may be applied.

The posterior termination is called *foramen commune posterius*, iter a tertio ad quartum ventriculum, canalis medius or aquæductus Sylvii.

There is an opening, leading downwards and forwards, from the foramen commune anterius to the infundibulum, called *iter ad infundibulum.*

The *infundibulum* is a conical body of cineritious and medullary substance, extending from the tuber cinereum and anterior and inferior part of the third ventricle to the pituitary gland.

The pituitary gland is of an oval form, and of a brownish colour externally. It is situated in the sella turcica of the sphenoid bone.

PARTS SEEN AT THE BASE OF THE BRAIN, PROCEEDING FROM THE FRONT TO THE BACK PART.

Looking down the separation of the anterior cerebral lobes, in the mesian line, we first see the anterior extremity of the corpus callosum.

On each side of the mesian line two whitish chords are seen lying in a groove of the anterior lobe; these are the olfactory nerves, with their anterior extremity enlarged, and of a grayish colour.

Laterally, the middle cerebral lobes are observed making an evident projection above the anterior lobes, from which they are separated by the fissure of Sylvius.

Proceeding backwards, in the middle line, are seen the optic nerves, separated anteriorly, united in the mesian line, and again diverging posteriorly. They may be traced over the crura cerebri to their origin in the thalami optici and tubercula quadrigemina.

Between the converging optic nerves, and internal convolution of the middle lobe, an angle is formed, in which part the pia mater enters the lateral ventricle to form the choroid plexus. This angular part of the anterior lobe is called the *substantia perforata antica*. It is placed between the optic commissure, the inner termination of the fissure of Sylvius, and the longitudinal fissure.

Immediately behind the conjoint optic nerves is a small gray process, called infundibulum, which is a hollow tube, leading from the third ventricle to the pituitary gland.

The base of the infundibulum is implanted on a gray eminence, called tuber cinereum, which forms part of the floor of the third ventricle, and is attached to the inner edge of the optic nerves.

Behind this are two little white bodies, called corpora albicantia, in which the anterior pillars of the fornix terminate. Internally they consist of gray matter.

Behind the corpora albicantia are two large bands of medullary matter, the crura cerebri. They have a grayish black substance, seen in their centre, when cut into, called locus niger.

Between the crura cerebri and the corpora albicantia there is a triangular space called pons tarini, or locus perforatus, which assists in forming the floor of the third ventricle.

On the inner edge of the crura cerebri and on the locus perforatus the fibres of the third pair of nerves are seen given off: they may be traced as far as the locus niger.

Behind the crura cerebri, and continuous with them, is seen a quadrilateral white eminence, called the pons varolii, or tuber annulare. Its upper part is covered by the tubercula quadrigemina, which form the upper wall of the aqueduct of Sylvius. Along its centre is seen a depression, occasioned by the passage of the basilar artery. It appears to be formed by the converging fibres of the cerebellum, and of which it is called the great commissure.

Along the external edge of the pons varolii is seen the fourth pair of nerves, which wind round the pons backwards and upwards towards the cerebellum, and may be traced to the valve of Vieussens.

From the middle of the outer edge of the pons varolii, the fifth pair of nerves is seen emerging in two bundles; the posterior largest, the anterior smallest.

At the posterior edge of the pons varolii, at about two or three lines from the mesial line, is seen the commencement of the sixth pair of nerves.

The posterior angles of the pons are continued obliquely outwards, forming the crura cerebelli; their upper part is continuous with the processus a cerebello ad testes, and their posterior portion with the corpora restiformia.

Behind the pons varolii is the medulla oblongata, separated from it by a deep depression, called foramen cæcum. It is thickest in front, smaller behind and downwards, and imperceptibly joins with the medulla spinalis. It is separated in the mesian line into two equal halves, each of which presents three eminences or cords.

The eminences on each side of the mesian line are the corpora pyramidalia. Their fibres interlace and are blended together.

On the outside of the corpora pyramidalia are the eminences called corpora olivaria. Their fibres take a course above the pons varolii, and their centre is of a grayish colour, which portion is named corpus dentatum olivare.

On the posterior and superior surface of the medulla oblongata, and at the sides of the corpora olivaria, are two other eminences, called corpora pyramidalia lateralia, or restiformia. They run obliquely upwards and outwards towards the cerebellum, in which they are expanded.

At the posterior and upper part of the medulla oblongata, and between the corpora restiformia, is a triangular depression, called sinus of the fourth ventricle, or calamus scriptorius. It is covered by some folds of pia mater, and white transverse fibres are observed in it, which appear to be the roots of the auditory nerve.

Lying against the crura of the cerebellum are two nervous cords, which form the seventh pair. The portio dura or facial nerve, the smallest, anterior, and to the inner side, comes from the posterior edge of the pons varolii, from the groove which separates the corpora olivaria and restiformia. The portio mollis, placed behind and outside the former, commences in the transverse band of the calamus scriptorius, then winds round the corpora restiformia, from which it also receives fibres, and passes over the crura cerebelli, where it generally forms a little ganglion. It is accompanied in part of its course by the facial, to which it generally adheres, and sometimes communicates with it by nervous filaments.

Between the corpora olivaria and restiformia a series of nervous filaments are seen, which constitute the eighth pair of nerves. They are subdivided into superior or glosso-pharyngeal and inferior, forming the par vagum.

The accessory nerve arises from the sides of the copora restiformia, and the continuation of these cords in the medulla spinalis, between the corpus dentatum and the posterior roots of the cervical nerves.

The great hypoglossal, or lingual nerve, arises between the corpora midalia and olivaria, by three bundles of roots.

Behind the pons varolii is seen the cerebellum.

CEREBELLUM.

The *cerebellum* is situated beneath the posterior part of the cerebrum, separated from it by the tentorium, and resting on the inferior fossæ of the occipital bone.

It is divided into two lobes, by a fissure occupied by the falx minor.

It is composed of cineritious and medullary matter, forming, by their internal arrangement, the appearance termed *arbor vitæ*.

An oval nucleus of gray substance is found in the medullary part, and, from its border being notched, is named *corpus dentatum*, or *rhomboideum*. This is considered to be a ganglion of increase to the formative fibres of the cerebellum.

Its surface is not convoluted, as the cerebrum, but formed into *lamellæ*, with *sulci* or grooves between them.

There are two *vermiform processes* observed on it; they have the appearance of rounded central ridges, situated superiorly and inferiorly, and serve to connect the lateral lobes above and below.

To some distinct projecting portions, termed lobules, separate names have been given, such as Pneumogastric lobule, Tonsils, Uvula, and Linguetta laminosa.

Two large cords pass from the cerebellum named *crura* *cerebelli*, and are continuous with the fibres of the pons varolii.

Between the cerebellum and medulla oblongata is a cavity running downwards and backwards, called the *fourth ventricle*.

It is bounded above by the valve of Vieussens; in front, by the medulla oblongata; behind, by the cerebellum; and below, by a process of arachnoid membrane; laterally, by the processus a cerebello ad testes.

It has a communication above with the third ventricle, through the *foramen commune posterius*.

A depression is observed at the anterior and inferior part of the fourth ventricle, called *calamus scriptorius*, from its pen-like form.

The *Medulla Spinalis* commences by the medulla oblongata, from beneath the pons varolii; it descends through the foramen magnum, down the spine, and terminates at about the first or second lumbar vertebra in the cauda equina.

Early in life it extends almost the entire length of the spinal canal. It is broader transversely, therefore presents a somewhat flattened appearance, and is broader in some parts than in others. The dilated portions are first at its upper part, where it approaches the pons varolii, next between the third and sixth cervical vertebræ, and again between the tenth dorsal and first lumbar vertebra.

It is composed of white matter externally, and gray internally; the latter, most abundant, is of a crescentic shape when divided transversely, and each lateral crescent is connected by its convex edge with the opposite one by a transverse portion of the same gray matter, which may be named a commissure.

It is divided into two lateral halves by an anterior and posterior fissure, which do not penetrate to the centre. The anterior one is intersected by transverse fibres, which pass from one side to the other, and form the anterior longitudinal commissure; this is not observable along the posterior part, where all the fibres are perpendicular. On the side of each lateral column two other imperfect fissures are mentioned, corresponding with the exit of the anterior and posterior spinal nerves, and between these, at the upper part of the medulla spinalis, about as far as the first dorsal nerve, a depressed line is described, extending from the fissure between the corpus olivare and restiforme.

The part named medulla oblongata is about one inch and a half long, and three quarters of an inch in breadth. It presents eminences which correspond with the other portions of the medulla spinalis, and, from their prominent character, have obtained separate names.

The anterior and posterior eminences, evidently the prolongation of the spinal marrow, are called anterior and posterior pyramids; the substance between these on each side is the corpus olivare. The line between the latter and the posterior pyramid (also named corpus restiforme) is called the tractus respiratorius of Sir C. Bell. The anterior pyramids and corpora olivaria are considered to be the formative fibres of the cerebrum; the posterior pyramids extend into the cerebellum.

The anterior pyramids, or corpora pyramidalia, are united anteriorly by some transverse fibres, forming a commissure.

The olivary bodies are white externally, gray internally. The gray matter, divided transversely, presents a scolloped-shaped margin, and is named corpus dentatum olivare.

The corpora restiformia, or posterior pyramids, diverge as they ascend to the cerebellum, and form the lateral inferior boundaries of the fourth ventricle.

The *arteries* which supply the *brain* are the *two internal carotid* and *vertebral arteries.*

The internal carotid artery gives off within the cranium, the *ophthalmic*, the *posterior communicating*, the *anterior*, and the *middle cerebral* arteries.

The vertebral arteries enter the skull through the foramen magnum, and give off the posterior arteries of the cerebellum; they then unite on the basilar process to form the *basilar artery*, which gives off the *superior arteries* of the *cerebellum*, and divides into the *posterior cerebral* arteries, called *profundæ cerebri*, which are distributed to the posterior lobe.

There is a communication between the branches of the internal carotids and basilar artery, forming an arterious circle, called the *circle of Willis*, which surrounds the optic commissure, the infundibulum, corpora albicantia, and pons tarini.

The veins terminate in the various sinuses, which empty themselves into the internal jugular veins.

NERVES.

The *nerves* are white medullary cords, necessary to sensation and motion.

They are composed of very fine filaments called *nervous fibres*, and each fibre consists of a cellular envelope called *neurilema*, and a central pulp of medullary substance. This pulp is considered by most to be globular.

There are two sets of nerves in the body, those belonging to the cerebro-spinal system, and those of the ganglionic. The former are named nerves of animal life by Bichat; the latter, nerves of organic life.

Each cerebro-spinal nerve has two extremities, one communicating with the brain or spinal cord, called its origin; the other, distributed to some of the organs or parts of the body, called the termination.

They thus form a communication between external objects and the brain, and convey to it the various impressions which constitute the senses.

Nerves communicate with each other in various places, forming plexuses.

Some nerves have enlarged parts on them called ganglia, differing somewhat in structure from the nerves themselves; their precise use is unknown.

The ganglia of the sympathetic nerve differ in appearance and structure from the cerebro-spinal ganglia. They are of a redder colour, have a cellular capsule, are more vascular, and are formed of both white and gray matter. They may be looked upon as so many nervous centres.

The nerves arise either from the brain or spinal marrow, they are divided into *cerebral* and *spinal nerves.*

CEREBRAL NERVES.

The cerebral nerves are generally described as nine pairs.

The *first pair* or the *olfactory nerves* take their origin by three roots, the outer and inner one medullary, the central one cineritious. The external, which is longest, arises from the end of the fissure of Sylvius; the internal from the substantia perforata antica; the central or gray portion from the substance of the anterior lobe. They soon unite, forming a white triangular cord, lodged in a groove at the base of the anterior lobe, about half an inch from the median fissure; and covered by the arachnoid, only on their under surface. Each cord is then expanded upon the cribriform plate of the ethmoid bone, to form the olfactory bulb, composed of white and gray matter, which gives out numerous medullary filaments, to pass through the cribriform plate of the ethmoid bone. These filaments, which receive an investment from the dura mater, are distributed upon the septum, roof of the nose, and the superior turbinated bones, by three series of filaments.

The *second pair* or *optic nerves*, arise from the corpus geniculatum externum and nates. They wind round the crura cerebri, and unite to form the optic commissure in front of the pituitary fossa, and between the anterior clinoid processes; they then separate and diverge, pass through the foramen opticum, into the orbit, perforate the sclerotica, by several small foramina, to the inner side of the axis of the eye, then pass through the choroid, and are lost or terminate in the retina.

In the commissure, some of the fibres of each nerve cross to the opposite side: those on the outside of each nerve seem to pass forwards on the same side, to their destination. A transverse section of the optic nerve in the orbit presents a dark central spot, named *porus opticus*, dependent upon the arteria centralis retinæ, which enters this nerve and runs along its centre.

The *third pair*, or *motores oculorum*, arise from the inner edge of the crura cerebri; they always run downwards and forwards, between the posterior artery of the cerebrum, and anterior artery of the cerebellum, then pass along the outer wall of the cavernous sinus, then traverse the sphenoidal fissure, to enter the orbit, dividing into two portions, superior and inferior, the superior branch entering between the heads of the external rectus. The superior portion gives off a branch to the superior rectus, and another to the levator palpebræ superioris; the inferior portion, larger, gives off three branches, one to the internal rectus, one to the inferior rectus, and the third to the inferior oblique muscle. The last gives a filament to the lenticular ganglion. They all run along the ocular surface of the muscles. In the cavernous sinus, this nerve is at first situated higher than the other nerves, but on passing into the orbit, it is below them; just before entering, it communicates by filaments with the carotic plexus and ophthalmic division of the fifth.

The *fourth pair*, or *pathetici*, arise from the valve of Vieussens, immediately beneath the tubercula quadrigemina; they run along the side of the pons varolii, perforate the dura mater, pass within the outer wall of the cavernous sinus, through the sphenoidal fissure, and are distributed to the trochlearis or superior oblique muscle of the eye. They are the smallest and longest of the cerebral nerves within the cranium. In the orbit they mount up over the levator palpebræ muscle, lying between it and the periosteum; and, as they enter the orbit, are the highest of the orbital nerves. Arnold describes a small branch from this nerve in the cranium, which runs upon the tentorium almost as far as the lateral sinus.

The *fifth pair* of nerves, or *trigemini*, resemble spinal nerves, being both for motion and sensation, and having, like them, a double origin. They seem to emerge from the junction of the pons varolii, with the crura cerebelli. The anterior or smallest fasciculus may be traced to the corpus pyramidale. The large posterior fasciculus, composed of nearly a hundred filaments, is derived from the corpus restiforme, conferring sensation. The nerve of each side passing forwards, enters a sheath of dura mater upon the petrous bone, and by expanding forms the semilunar or Casserian plexus, or ganglion, on the anterior surface of the petrous portion of the temporal bone, and part of the sphenoid bone. From this plexus, three trunks are given off, the *ophthalmic*, *superior*, and *inferior maxillary*. The first two are only nerves of sensation, the last a nerve of sensation and motion.

The *ophthalmic trunk*, the smallest of the three, and most internal, runs along the outer wall of the cavernous sinus, below the third and fourth nerves, communicating slightly with the cavernous plexus; then separates into three branches, which perforate the dura mater separately, to enter the orbit by the sphenoidal fissure—they are the following:

1. The *lacrymal* branch, smallest and lowest of the three, passes between the periosteum and external rectus, to be distributed to the lacrymal gland, external canthus, and upper eyelid. It communicates by small twigs with the superior maxillary, and sends a twig or two through the malar bone, to communicate with the deep temporal nerves.

2. The *frontal* branch, largest, passes along the orbit, between the periosteum and the levator palpebræ superioris; midway in its orbital course, it divides into two branches, the *supraorbital* and *supratrochlear;* the latter emerges above the trochlea of the superior oblique, and runs beneath the muscles, then perforates the occipito-frontalis, and is distributed to it and the integuments of the head; the other

filament passes out at the supraorbital notch, is distributed to the occipito-frontalis, and parts about the forehead, communicating, as well as the other, with the temporal branch of the portio dura.

3. The *nasal* branch passes between the two heads of the external rectus, then crosses over the optic nerve, communicating in that spot with the lenticular ganglion, and giving off two ciliary branches, which accompany the ciliary nerves of the lenticular ganglion; and at the inner wall of the orbit dividing into two branches, called *nasal* and *infratrochlear*. The nasal twig emerges at the foramen orbitarium internum anterius, enters the cranium, and passing down in the anterior foramen of the cribriform plate of the ethmoid bone, is distributed to the septum and extremity of the nose. The infratrochlear twig is distributed to the root of the nose, the tensor tarsi, and lacrymal sac, upper eyelid, and caruncula, and communicates with thesupratrochlear nerve.

The *superior maxillary nerve* leaves the cranium by the foramen rotundum, then crosses the spheno-maxillary fossa, passes along the infraorbitar canal, escapes at the infraorbitar foramen, under cover of the orbicularis palpebrarum and levator labii superioris, and is ultimately distributed upon the cheek.

In its course it gives off the following branches:

1. An orbital branch, which communicates with the lacrymal, and sends twigs to the orbicularis palpebrarum and skin, and a malar twig, which perforates the malar bone, and anastomoses with the deep temporal nerves.
2. Two descending branches, communicating with Meckel's ganglion.
3. Four or five posterior dental branches, which perforate the tuberosity of the superior maxillary bone, to supply the molar teeth, and one filament which runs superficially to supply the gums.
4. Anterior dental, for the supply of the bicuspid, canine, and incisor teeth. These nerves run partly along the walls of the antrum, partly within the bone.

Its terminating filaments communicate with the nasal branch of the ophthalmic and facial twigs of the portio dura, upon the cheek.

The *inferior maxillary nerve*, consisting of two separate portions, passes from the cranium by the foramen ovale of the sphenoid bone.

The two portions unite as soon as they pass through the foramen, but appear to separate almost immediately, in the form of two trunks.

The superior and smallest one gives off the following branches:

1. The *deep temporal* branches, two in number, distributed to the temporal muscle. They perforate the muscle, and communicate with the superficial temporal nerves.
2. The *buccal* branch, supplying the buccinator muscle and muscles of the cheek.
3. The *pterygoid* branch, chiefly to the internal pterygoid muscle.
4. The *masseteric* branch, for the supply of the masseter muscle.

The inferior trunk of the inferior maxillary nerve divides into three branches, the *gustatory*, the *auricular*, and *inferior dental*.

1. The *gustatory* nerve descends, first, between the two pterygoid muscles, next, between the internal pterygoid muscle and ramus of the lower jaw, then arrives upon the upper surface of the mylo-hyoid muscle, and outer surface of the hyoglossus; accompanies there the Whartonian duct, runs over the sublingual gland, and ultimately arrives at the tip and sides of the tongue, to be distributed to the papillæ. In its course it unites with the inferior dental nerve, by a large branch, and also with the chorda tympani nerve, which attends it for a short distance, and then leaves it to pass on to the submaxillary ganglion. Filaments are given off from it, to the

   Internal pterygoid muscle,
   Tonsils, soft palate, gums, and pharynx,
   Submaxillary gland,
   Hypoglossal nerve,
   Sublingual gland,
   and terminating filaments to the substance and papillæ of the tongue.

2. The *auricular* or *superficial temporal* passes outwards between the condyle of the lower jaw and external auditory meatus. It runs within the parotid gland, and in that situation divides into two branches, superior and inferior. The superior one passes upwards with the temporal artery, to the side of the head, communicating with the portio dura, and giving a filament to the articulation of the lower jaw and meatus externus. The other branch passes backwards behind the ear, giving filaments to it, and uniting with filaments from the cervical nerves.

3. The *inferior dental* nerve passes first between the pterygoid muscles, then between the internal pterygoid and ramus of the lower jaw, and enters the dental canal; reaching the foramen mentale, it divides into two branches, one runs forwards to the symphysis, uniting with the opposite nerve, and supplying the canine and incisor teeth, the other passing out, called mental nerve, is distributed to the soft parts about the chin and lower lip.

In its course it receives a large short branch from the gustatory; and just before entering the dental foramen, it gives off the mylohyoidean branch, to the mylo-hyoid muscle, the submaxillary gland, and digastric muscle.

In the dental canal it distributes twigs to the molar and bicuspid teeth.

The *sixth pair*, or *abducentes*, arise from the junction of the pons varolii with the corpora pyramidalia; they then pass through an opening in the dura mater; and pass near the inner wall of the cavernous sinus; and, on the outside of the carotid artery, give filaments to communicate with the sympathetic; they then pass through the sphenoidal fissure, run between the two heads of the external rectus, divide into filaments, to be distributed to the external rectus, or abducens muscle of the eye.

The *seventh pair* consists of two portions, the *portio dura* and *portio mollis.*

The *portio dura*, or *facial nerve*, arises from a fissure between the corpora olivaria and restiformia, near the posterior edge of the pons varolii; it passes along the meatus auditorius internus in a groove of the portio mollis, and here unites with it slightly, then enters the canal of Fallopius, where it unites with the petrous branch of the vidian nerve; in its course it gives a filament to the tensor tympani, and to the stapedius muscle.

It then emerges at the foramen stylo-mastoideum, and, before its ultimate division, gives off three small branches:

1. The *posterior auricular* to the occipital muscle, the retrahens aurem, and external meatus.

2. The *stylo-hyoid* to the stylo-hyoid and digastricus muscles.
3. The *digastric* branch to the posterior belly of the digastric muscle.

These three filaments all communicate with the neighbouring nerves.

The portio dura then enters the parotid gland, and divides into two, three, or more branches, named temporo-facial and cervico-facial, which, by communicating filaments, form the pes anserinus: from this, three sets of branches pass off:

1. The temporal pass up over the zygoma, ramifying on the head and ear, and anastomosing with the occipital and frontal nerves.
2. The malar branches anastomosing with the superior and inferior maxillary nerves, and supplying the muscles of the face.
3. Descending branches anastomosing with the inferior maxillary on the lips and chin, and with the cervical nerves in the neck, supplying the platysma and integuments.

The filaments of the portio dura give the power of motion to the various muscles upon which they are distributed.

The *portio mollis* arises from the anterior part or floor of the fourth ventricle; it enters the meatus auditorius internus, in company with the portio dura, separated from it only by a small artery given off from the basilar: at the bottom of the canal it divides into minute filaments, which form two fasciculi; the anterior go to the cochlea, the posterior to the vestibule and semicircular canals.

The *eighth pair* consists of three nerves:

1st. The *glosso-pharyngeus* arises from the side of the medulla oblongata, in the groove between the corpus olivare and restiforme, and between the portio dura and nervus vagus; it passes forwards and out of the cranium, by the foramen lacerum posterius, anterior to the jugular vein; descends perpendicularly almost in front of the carotid artery, passing between the stylo-pharyngeus and stylo-glossus muscles, towards the root of the tongue; as it escapes from the cranium it forms a ganglionic enlargement.

The branches given off from it have been minutely traced by Arnold (vide Icones Nervorum Capitis), and are the following:

The tympanic branch from the ganglion, gives a filament to the carotic plexus, to the vidian in the hiatus Fallopii, and one to the otic ganglion.
A branch to anastomose with the portio dura.
A branch to the nervus vagus and accessorius.
Branches to the stylo-hyoid and digastric muscle.
Pharyngeal branches to the pharyngeal plexus.
Tonsillary branches.
Terminal branches to the mucous membrane and follicles at the root of the tongue.

2d. The *nervus vagus*, *par vagum*, or pneumogastric nerve, arises just below the glosso-pharyngeus, in the same fissure: it forms a flattened band and passes out of the cranium by the foramen lacerum posterius, invested by a prolongation of dura mater; just at its exit it has a gangliform enlargement, and here communicates with the lingual, the glosso-pharyngeal, and sympathetic nerves; it next lies upon the rectus capitis anticus major, descends in the neck inclosed in the carotid sheath between the carotid artery and internal jugular vein; enters the thorax between the subclavian artery and vein, on the right side, giving off the right recurrent branch, which curves round the subclavian artery, and runs along the side of the trachea to the larynx; on the left side it enters the chest parallel with the left subclavian artery, and sends off a recurrent branch, which winds round the arch of the aorta to be distributed like the recurrent of the right side; it then gives filaments to the bronchi, and passes downwards and backwards to the œsophagus, to which it supplies numerous filaments, which interlace freely together, forming the œsophageal plexus; these reunite and form a trunk on each side of the œsophagus, that on the right side being behind, that on the left being in front, and passing through the diaphragm, is finally distributed upon the stomach.

The particular branches of the par vagum are the following:

1. The *pharyngeal* branch, which forms, with filaments of the sympathetic, laryngeal, and glosso-pharyngeal nerves, the pharyngeal plexus upon the middle constrictor.
2. The *superior laryngeal* nerve, which descends on the inside of the carotid artery, and divides into two branches; the external one distributed to the thyro-hyoid, sterno-hyoid, and crico-thyroid muscles, and the thyroid gland; the other internal perforating the thyro-hyoid ligament is distributed to the epiglottis and its glands, the arytenoid muscle, the membrane lining the larynx, and the crico-thyroid muscle, and anastomoses with the inferior thyroid.
3. *Cardiac* branches, to anastomose with the superficialis cordis.
4. The *recurrent* or *inferior laryngeal* passes along the side of the trachea, and reaching the larynx is distributed to the crico-arytenoid and thyro-arytenoid muscles; in its course it gives filaments to the pulmonary plexus, to the œsophagus and under surface of the trachea, to the inferior constrictor of the pharynx, and anastomoses with the superior laryngeal nerve.
5. *Bronchial* branches, forming, with the recurrent and sympathetic, the anterior and posterior pulmonary plexus.
6. *Œsophageal* branches, forming a plexus around the œsophagus. The terminating branches ramify on the stomach, anastomosing with the hepatic, coronary, and solar plexus.

3d. The *nervus accessorius*, or superior posterior respiratory nerve, takes its origin in the cervical portion of the spinal cord, as low as the fourth or fifth cervical vertebra; it then passes into the cranium, through the foramen magnum, and quits it, by the jugular foramen; passing behind the internal jugular vein, it descends in the neck, perforating the sterno-mastoid muscle, to which it gives filaments, and is ultimately distributed to the trapezius muscle.

The *ninth*, hypoglossal, or lingual, arises from between the corpora pyramidalia and corpora olivaria: the fibres unite into a trunk on each side, which passes out at the anterior condyloid foramen, internal to the par vagum and sympathetic; it passes forward between the internal carotid artery and internal jugular vein, and descends and runs parallel with the lower margin of the digastric muscle; as it turns forwards it hooks round the occipital artery, and here gives off its descendens noni branch, then runs above the os hyoides on the outer surface of the hyo-glossus muscle, and is ultimately distributed to the genio-hyo-glossus and lingualis muscles. The branches from it are the following:

Filaments to connect it with the glosso-pharyngeal, nervus vagus, accessorius, sympathetic, and nervous loop of the atlas.

The *descendens noni* branch, which runs down upon the carotid sheath, and, anastomosing with filaments of the cervical nerves, forms an arch, convex downwards, from which filaments are distributed to the omo-hyoid, sterno-hyoid, and sterno-thyroid muscles.

Filaments to the stylo-pharyngeus, constrictors of the pharynx and crico-thyroid muscle.

Filaments to surrounding muscles.

Filaments to communicate with gustatory and terminal filaments, to the lingualis and genio-hyo-glossus muscles.

The *Spinal nerves* consist of thirty pairs: eight cervical, including the suboccipital, twelve dorsal, five lumbar, and five sacral nerves.

They arise by two fasciculi: those from the front give the power of motion; those from behind give sensation: they pass through the dura mater, then unite and perforate the lateral foramina of the vertebral canal, dividing into an anterior and posterior series. The anterior ones are generally the largest. A ganglion is formed on the posterior fasciculus, within the dura mater, before the union, and before the dura mater entirely quits the nerve.

CERVICAL NERVES.

The first *cervical*, or *suboccipital*, the smallest of the series, passes out of the spinal canal between the occipital bone and arch of the atlas: it then appears in the triangular space bounded by the rectus capitis posticus and oblique muscles, and divides into an interior and posterior branch. The *posterior* one gives filaments to the small adjacent muscles and complexus, and a descending filament to the next nerve. The *anterior* branch runs forwards to the anterior surface of the spinal column, where it gives off the following filaments:

One to the second cervical nerve, descending before the atlas, and forming the *nervous loop* of the atlas.
.... nervus vagus.
.... lingual nerve and first cervical ganglion.

The next three cervical nerves, uniting together by anterior descending branches, are described as forming the cervical plexus. Their posterior branches may be described separately.

The second cervical nerve emerges between the atlas and vertebra dentata. The posterior branch, named *great occipital nerve*, larger than the anterior, runs upwards and backwards towards the occiput, and perforates the complexus muscle; after which it ascends with the occipital artery, and is distributed over the scalp, communicating with the frontal branches of the ophthalmic, ascending branches of the pes anserinus, and auricular branch of the inferior maxillary nerve. In its course it gives filaments to the

First and third cervical nerves;
Posterior recti, and oblique muscles;
Splenius, and complexus.

The third cervical nerve emerges between the vert. dentata and third cervical vertebra.

Its *posterior* branch, smaller than that of the second, winds backwards, perforates the muscles to become subcutaneous, and is distributed to the back of the head and neck. It gives off filaments to the second and fourth cervical nerves, and the various contiguous muscles.

The fourth cervical nerve emerges, like the former, from between the third and fourth cervical vertebræ. Its *posterior* branch is very small: it runs between the transverse processes of the corresponding vertebræ, gives filaments to the complexus splenius and trapezius, perforates the two latter muscles, and terminates in the integuments of the neck.

The anterior branches of the second, third, and fourth cervical nerves, soon after their exit, unite by filaments to form the *cervical plexus;* they communicate by filaments with the superior cervical ganglion, sometimes with the middle ganglion.

The cervical plexus rests upon the splenius colli, the anterior border of the scalenus posticus and levator anguli scapulæ, and is covered over by the sterno-mastoid muscle: the branches given off from it may be divided into superficial and deep. Most of the superficial are seen winding round the posterior edge of the sterno-mastoid muscle, to reach its external surface, but some descending as far as the clavicle.

The *superficial* branches are the following:

1. *Posterior* or *small occipital,* ascends along the posterior edge of the sterno-mastoid muscle to the occiput, giving filaments to the back of the ear and occipital integuments. It anastomoses with the nervus accessorius and portio dura.

2. *Middle* or *great auricular nerve,* first crosses the sterno-mastoid muscle, a short distance above the external jugular vein, ascends towards the parotid gland, where it divides into filaments; some enter the gland and unite with the portio dura, others mount up in front of the ear, others ascend behind it, and are distributed to the integuments.

3. The *anterior branch, transverse cervical* or *superficialis colli,* ascends and inclines towards the submaxillary gland, supplying filaments to the digastric muscle and platysma myoides, and to the submaxillary ganglion or plexus; thus communicating with the lingual and chorda tympani.

4. The *descending filaments* pass between the trapezius and sterno-mastoid muscle, and are distributed to the integuments about the clavicle, acromion, the omo-hyoid, and serratus magnus muscle. They may be named *supraclavicular, supraacromial,* and *subclavicular.*

The deep branches of the cervical plexus are the following:

Some, to communicate with the nervus accessorius, and to supply the trapezius and levator anguli scapulæ.

Branches to unite with the descendens noni.

The *phrenic,* chiefly derived from the third and fourth, receives also a filament from the fifth cervical nerve. It descends in the neck, upon the anterior scalenus muscle; enters the chest, between the subclavian artery and vein, communicating here with the nervus vagus, or recurrent nerve, and inferior cervical ganglion; it then passes anterior to the root of the lungs, runs between the pleura and pericardium, which it grooves, and arrives at the diaphragm, to the muscular fibres of which it is principally distributed; on the right side it sends filaments through the opening of the vena cava, to the surface of the liver; others penetrating the diaphragm, and reaching its under surface, accompany the branches of the phrenic artery, to reach the solar plexus. The left phrenic nerve is longer than the right, having to wind round the apex of the heart.

The fifth, sixth, seventh, and eighth cervical nerves, with the first dorsal, by their anterior branches, and filaments from the sympathetic, form the *brachial plexus.* The posterior branches of the four inferior cervical nerves are very small, and are distributed to the deep-seated muscles and integuments of the immediately surrounding parts.

The nerves about to form the *brachial plexus* pass out from between the scaleni muscles, and then combine to form this plexus. The fifth and sixth form together a single trunk, as also the eighth cervical and first dorsal, whilst the seventh cervical runs some distance before joining the plexus.

The plexus passes downwards and outwards beneath the subclavius muscle, and over the first rib; and in the axilla, opposite the coracoid processes, divides into its terminal branches.

Its branches consist of those distributed to parts above the arm, and those which go to the arm entirely; of the latter there are six, namely, the external and internal cutaneous, the circumflex, ulnar, median, and musculo-spiral, or radial; of these, three only reach the fingers, namely, the ulnar, median, and musculo-spiral. The first series from the plexus includes the suprascapular, subscapular, and thoracic nerves.

The *suprascapular nerve*, given off from the plexus, high up, passes outwards and backwards towards the superior margin of the scapula, accompanying the artery of the same name. It runs through the suprascapular notch, where it gives off a branch to the supra-spinatus muscle, and passing beneath the acromion process, is distributed to the infraspinatus and teres minor muscles.

The *subscapular* branches are generally three; they run down in the course of the subscapular artery, supplying filaments to the subscapularis muscle, teres major, and latissimus dorsi.

The *thoracic* nerves are three or four in number: two of these run down in front of the axillary vessels, to reach the pectoralis major and minor, upon which they are distributed; the other, named posterior thoracic, descends behind the axillary vessels to the inside of the axilla, distributing filaments to the serratus magnus muscle. It is the posterior inferior respiratory nerve of Sir C. Bell. This nerve is described by many as coming off from the cervical plexus, at about the same point as the phrenic nerve, but posterior to it.

NERVES OF THE ARM.

The *internal cutaneous* nerve is the smallest of the brachial branches of the plexus : it descends along the inside of the arm, under the fascia, and divides near the elbow into two branches, which perforate the fascia, and then run quite superficially. Before the division it gives off filaments, which perforate the fascia, and are distributed to the integuments covering the triceps and biceps. The terminal branches are the following :

The *anterior* branch passes over the mĕdian basilic vein, and descends as far as the wrist : in its course giving filaments to the integuments ; some to communicate with the external cutaneous, and some to join with the other branch of the same nerve.

The *internal* branch inclines quite to the inner side of the forearm, and runs down to the wrist ; in its course it gives filaments to the integuments, some to unite with the other branch, and terminating filaments to the inner border of the hand.

The *external cutaneous* nerve, also named *musculo-cutaneous* and *perforans casserii*, larger than the former, proceeds from the upper and external portion of the plexus, descends, and generally perforates the coraco-brachialis muscle ; then runs downwards and outwards, under the biceps, and upon the brachialis anticus muscle ; then between the biceps and supinator radii longus ; it then perforates the fascia and becomes superficial, runs between the median cephalic vein and fascia, and descends as far as the wrist, where it terminates. Its branches are the following :

Muscular filaments to the coraco-brachialis, biceps, and brachialis anticus.

Filaments to the integuments, communicating with those of the internal cutaneous and musculo-spiral.

Terminating filaments to the root of the thumb and the wrist, communicating with cutaneous filaments of the median.

The *circumflex* nerve proceeds from the posterior part of the plexus, backwards and outwards, beneath the inferior edge of the subscapularis muscle, accompanies the posterior circumflex artery behind the humerus, and winds round it, to reach its anterior-external surface, where it is finally distributed to the deltoid muscle. It also gives filaments to the subscapularis, teres major, and triceps, and to the skin covering the latter.

The *ulnar* nerve arises from the inner side of the plexus, descends along the inner side of the arm, supported by the short head of the triceps, as far as the space between the inner condyle and the olecranon; here it passes between the two origins of the flexor carpi ulnaris, and coursing along the forearm, rests upon the flexor digitorum profundus, to the ulnar side of the artery, overlapped by the flexor carpi ulnaris; lower down it runs distinctly along the radial edge of the flexor ulnaris; when arrived at the wrist it passes over the annular ligament with the ulnar artery, and in the hand divides into two terminating branches, the superficial and deep. The filaments given off by it are the following:

One or two to teres major and latissimus dorsi.

.... to the long and short head of triceps.

In the forearm filaments to the adjacent flexor muscles, communicating with the median.

A branch quits it, about the upper part of the lower third of the forearm, runs under the flexor carpi ulnaris, and arrives at the surface of the extensor ulnaris to reach the little finger. It gives a filament to the abductor minimi digiti, and another which bifurcates to supply the opposed surfaces of the ring and little finger, and communicates with the digital filaments of the musculo-spiral.

The *superficial* branch of the hand goes to supply the little finger and half the ring-finger; one branch of it runs along the muscles of the little finger, giving them filaments, and courses along the ulnar side of this finger, as far as the tip; the other filament runs along the surface of the adductor minimi digiti, and having united with a filament from the median, on arriving at the head of the fourth and fifth metacarpal bones, bifurcates to supply the opposed surfaces of the ring and little fingers.

The *deep-seated* palmar branch, forming the deep arch of nerves, sinks deep in the hand, passing beneath the adductor minimi digiti, and running upon the interossei muscles, beneath the flexor tendons, and terminating by filaments to the adductor pollicis. It gives filaments to the small muscles of the fingers, and to the interossei muscles.

The *median nerve* takes its origin from the brachial plexus, by two roots which embrace the axillary artery; they soon unite to form a single nerve, which descends about half way down the arm, on the outer side of the brachial artery; after which the nerve inclines over the artery, then gets to its inner side, gradually diverging from it, so that at the bend of the elbow there is a distinct space between them. In this course it rests upon the coraco-brachialis and brachialis anticus, internal to the biceps muscle; it then sinks in the space between the pronator teres and supinator longus, passes between the two origins of the pronator teres, and descends between the flexor sublimis and profundus, passes under the annular ligament at the wrist, and terminates in the hand by its digital branches. The branches and filaments given off by it are the following:

A few *muscular* twigs in the arm, to the muscles which arise from the inner condyle.

The *anterior interosseous* nerve, which accompanies the corresponding artery, runs between the flexor profundus and flexor pollicis longus, as far as the pronator radii quadratus; it runs beneath this and perforates the interosseous ligament, to arrive at the dorsal surface of the hand, to which it distributes filaments.

A small branch near the wrist passes over the annular ligament to the skin of the palm of the hand.

The terminating digital branches are five; and, with a branch from the ulnar, form the superficial palmar arch of nerves:

The *first* goes along the outside of the thumb, to its extremity, giving filaments to the abductor and flexor brevis.

The *second* runs along the inside of the thumb.

The *third* gives filaments to the abductor indicis and first lumbricalis, and runs along the outside of the index-finger.

The *fourth* takes the course of the second metacarpal space, gives a filament to the second lumbricalis, and bifurcates to supply the opposed sides of the index and middle fingers.

The *fifth* lies in the next metacarpal space, supplies the third lumbricalis, and bifurcates to supply the opposed sides of the middle and ring fingers; this branch communicates with the ulnar nerve, as before mentioned.

The *musculo-spiral* or *radial nerve*, one of the largest branches of the brachial plexus, emerging from its centre and posterior part, soon after its origin inclines downwards, outwards, and backwards, winds round the humerus, under the second head of the triceps, accompanied by the superior profunda artery; it next appears between the supinator longus and brachialis anticus, between which it runs as far as the elbow, where it divides into an anterior or external and a deep-seated branch.

The *anterior* branch descends with the supinator longus muscle, and, at about the middle third of the forearm, arrives at the outer side of the radial artery, which it accompanies for about two or three inches; it then leaves it, passing under the supinator muscle, running superficially to the extensor muscles of the thumb, and just above the wrist, dividing into terminal branches, which reach the back of the hand. The filaments from it are,

Several *muscular* filaments to the supinator and extensor muscles.

Terminal filaments, generally three in number; one to the radial side of the thumb.

One bifurcates to supply the ulnar side of the thumb and the radial side of the index-finger.

The third bifurcates to supply the opposed sides of the index and middle fingers, and occasionally a fourth supplies the opposed sides of the middle and ring-fingers.

The *deep-seated* branch, larger than the other, passes backwards and downwards beneath the supinator longus and two radial extensors, then perforates the supinator brevis, and divides into several filaments.

Some to the extensors of the thumb and fingers.

One named *posterior interosseous*, which descends with the deep-seated extensor muscles, as far as the back of the carpus. It supplies the muscles in its course.

The filaments of the musculo-spiral given off before its division are the following:

Two or three to the triceps: one of these arrives at the skin, and has been named *superior external cutaneous* nerve; it descends upon the forearm, and communicates with the external cutaneous nerve.

Then the muscular branches before mentioned.

In addition to the nerves above described as coming from the brachial plexus, the inside of the arm is supplied with branches given off from the second and third intercostal, and have been named the cutaneous nerves of Wrisberg.

DORSAL NERVES.

The dorsal or intercostal nerves are twelve on each side. They emerge from the intervertebral foramina; the first between the first and second dorsal, the last between the last dorsal and first lumbar vertebra. Immediately after their exit they divide, like the cervical, into anterior and posterior branches; the posterior branches run backwards between the transverse processes of the vertebræ, to supply the deep muscles of the back and the integuments.

The *anterior* branches, named also intercostal, run along the intercostal spaces, below the vein and artery, and near the margin of each rib, between the external and intercostal muscles: about midway, between the spine and sternum, they give off a large superficial branch. The continued portion of the seven superior nerves is distributed to the intercostal muscles and triangularis sterni, and then perforates these, to be lost finally in the pectoralis major and integuments.

The next four intercostal nerves, corresponding with the four superior false ribs, on reaching the ends of the cartilages, pass forwards between the internal oblique and transversalis muscles, to reach the rectus abdominis, supplying filaments to all these muscles.

The filaments from these several dorsal nerves are as follows:

From each a filament or two of communication to the contiguous ganglion of the sympathetic.

The first dorsal nerve is large, and enters almost entirely into the formation of the brachial plexus.

The superficial branches of the second, third, and occasionally the fourth, after perforating the external intercostal muscles, cross the axilla, descend to the inside of the arm, as low down as the inner condyle, communicating with the internal cutaneous nerve. They are by some named *intercosto-humeral* nerves, or nerves of Wrisberg.

The superficial branches of the seven succeeding intercostal nerves are distributed to the mamma, pectoralis major, external oblique muscle, and integument, according to their situations.

The twelfth dorsal differs from all the others; it first sends a large branch to the first lumbar nerve, then passes forwards and a little downwards upon the quadratus lumborum, at the edge of which it divides into two filaments; the deep one passes forwards to the space between the transversalis and internal oblique muscle, to reach the rectus, supplying filaments to each. The superficial filament runs between the internal and external oblique muscles, supplying them and the integuments.

LUMBAR NERVES.

The lumbar nerves are five in number, and have a double origin, like the dorsal nerves. They form part of the cauda equina. They pass out of the canal at the intervertebral foramina, and soon after their exit divide into anterior and posterior branches: the first emerges between the first and second lumbar vertebræ, the fifth between the last lumbar vertebra and the sacrum.

The *posterior* branches take a course backwards, between the corresponding transverse processes of the vertebræ, and supply the deep lumbar muscles.

The *anterior* branches pass downwards and somewhat outwards, are connected together by twigs, and with the filaments of the sympathetic form an interlacement, named lumbar plexus. These nerves increase in size from above downwards.

The *lumbar plexus* is formed in the substance of the psoas muscle, by the four superior lumbar nerves, and receives branches from the last dorsal and the sympathetic ganglia, along the sides of the bodies of the lumbar vertebræ.

The branches given off by the plexus are:

Musculo-cutaneous,
External cutaneous,
.... pudic,
Crural,
Obturator,
and a communicating branch to the sacral plexus.

The *musculo-cutaneous* branches, two in number, chiefly from the first lumbar nerve, pass through the psoas muscle, forwards upon the anterior surface of the quadratus lumborum, to reach the crista ilii. These branches may be considered external and internal.

The *external,* named also *ilio-scrotal,* passes between the transversalis and internal oblique muscles, and gives off filaments which supply the transversalis and iliacus muscles, and subcutaneous filaments to the gluteus medius and maximus; one part of it passes forwards along the crista of the ilium, then follows Poupart's ligament, and gives filaments to the spermatic cord, the pubes, and scrotum, and in females to the labia.

The *internal* branch runs between the transversalis and internal oblique, and then between the latter and external oblique muscle, and is ultimately lost in the groin and scrotum.

The *external cutaneous nerve*, arising chiefly from the second lumbar, passes downwards and forwards, upon the iliac fascia, towards the anterior superior spinous process of the ilium, below which it passes and gets out of the pelvis. It pierces the fascia lata, and is distributed by two filaments; one passing downwards and sub-cutaneous to the outer part of the thigh, the other running down as far as the outside of the knee.

The *external pudic nerve*, also named *genito-crural* or *external spermatic*, appears to come off chiefly from the second lumbar nerve; it pierces the psoas muscle and descends upon its anterior surface, and at the crural arch divides into two branches, named internal and external.

The *internal* branch accompanies the spermatic cord of the male, or round ligament in the female, and is distributed to the cremaster and coverings of the testicle and adjacent parts of the groin; or to the pubes and labia of the female.

The *external* branch is distributed to the glands and parts in front of the thigh.

The *crural nerve* appears to be derived from the second, third, and fourth lumbar nerves. It is at first placed between the psoas and iliacus muscles, then descends under the fascia iliaca, and passes under the crural arch on the outside of the psoas muscle, which separates it from the femoral artery. In this course it gives twigs to the iliacus and psoas muscles. After passing Poupart's ligament it divides into several branches, superficial and deep. The superficial branches soon pierce the fascia lata, and extend as far as the front and inner side of the knee. The deep branches may be divided into

External,
Internal,
Descending.

The *external* branches pass in front of the iliacus and psoas, supplying filaments to the sartorius, rectus, tensor vaginæ femoris, two vasti and cruræus muscles.

The *internal* branches pass beneath the femoral vessels to supply the pectineus and adductor longus.

The *descending* branches accompany the femoral artery; one, *shorter*, runs on its outer side, giving filaments to the sartorius, and is lost in the vastus internus, near the knee. The *longer* branch runs on the sheath of the artery, and passes under the fascia, which extends from the adductors to the vastus internus; it quits the artery at the opening of the great adductor, and runs along the inside of the knee, and then accompanies the internal saphena vein, as far as the dorsum of the foot, where it terminates, by sending filaments to the inner side of the foot and great toe. This branch is named *nervus saphenus internus.*

The *obturator nerve* seems to arise from the third and fourth lumbar, passes along the inner edge of the psoas, between the peritoneum and pelvic fascia to reach the obturator foramen, which it passes through, and then gives off branches

To the *external obturator muscle,*
A filament to the hip-joint,
A deep posterior branch to the adductor magnus,
An anterior branch to the gracilis, and long and short adductors, and inside of the knee.

The *lumbo-sacral nerve* is the last given off from the lumbar plexus. It is formed from the anterior branch of the fifth and a twig from the fourth; it passes down to the pelvis and unites with the first sacral, so as to contribute to form the sacral plexus.

The only nerve given off from it is the superior *gluteal nerve*, which passes out at the sacro-sciatic notch, with the gluteal artery, and is distributed to the gluteal muscles.

The *sacral nerves* are five or six on each side, each consisting of an anterior and posterior branch; they arise from the cauda equina, and emerge from the sacral foramina.

The four *superior posterior* branches pass out at the posterior sacral foramina, perforate the tendon of the sacrolumbalis and become superficial, and are distributed to the skin covering the nates.

The inferior *posterior* branches run downwards to supply the integuments about the anus.

The *anterior* branches pass out at the sacral foramina, decreasing in size as they come out, from above downwards. They all communicate with the sacral ganglia of the sympathetic. The three superior nerves, with descending branches from the fourth and fifth lumbar nerves, and a branch from the fourth sacral, form the *sacral plexus*.

The fourth nerve gives filaments to the hypogastric plexus, levator ani, coccygeus, the skin about the anus, and sphincter ani.

The fifth and sixth sacral nerves are very small, and are lost in the coccygeus and sphincter ani.

The *sacral plexus*, formed as above mentioned, rests upon the pyriformis muscle, and gives off internal and external branches. The internal branches are

Hæmorrhoidal,
Vaginal,
Uterine,
Vesical,
Pudic.

The external branches are

Great Sciatic,
Small Sciatic.

The *hæmorrhoidal branches* pass to the muscular and mucous coat of the rectum, and communicate with the neighbouring nerves.

The *vaginal* and *uterine* branches ramify as their names imply.

The *vesical* branches pass to the lower part of the bladder and supply its muscular and mucous coat, the prostate gland and vesiculæ seminales; and in the female, the urethra.

The *pudic nerve* is the largest of the internal branches, and appears to come chiefly from the third sacral. It follows very closely the course of the pudic artery; the branches given off by it are,

A *superficial perineal* branch, which gives off long twigs to the sphincter ani, and margin of the anus, and filaments to the erector penis, accelerator urinæ, and transversus perinæi, and is lost upon the dartos and scrotum.

Branches to the obturator internus.

. . . . integuments, urethra, and glans penis.

The superficial perineal branch is largest in the female, and is distributed chiefly upon the labia.

The *small sciatic nerve* gets out from the pelvis, below the margin of the pyriformis muscle, to the inner side of the great sciatic nerve, supported by the superior gemellus, and overlapped by the gluteus maximus. Its branches are,

Inferior gluteal, consisting of small filaments, to the gluteus maximus.

Posterior and *internal cutaneous*, which passes inwards, beneath the tuber ischii, gives filaments to the gracilis, and, perforating the fascia, is distributed to the integuments about the inside of the thigh, scrotum, or labia.

Middle cutaneous pierces the fascia, and descends, supplying the skin, as far as the popliteal space.

The rest of the nerve descends and gives filaments to the flexor muscles, as far as the inside of the ham.

The *great sciatic nerve* is the largest nerve of the body.

It passes out of the pelvis, below the pyriformis muscle, then descends between the great trochanter and tuber ischii, over the small rotators, viz. the gemelli, obturator internus, and quadratus femoris, then rests upon the adductor magnus, under cover of the flexors of the thigh, and descends towards the popliteal space.

There are small branches given off by it

to the internal obturator muscle, and to the lesser sciatic nerve.
filaments to the gluteus maximus.
.... flexor muscles.
superficial branches which pierce the fascia, and are distributed to the outside of the knee, forming external cutaneous branches.
filaments to the external rotators.
.... hip-joint.
.... adductor magnus, and
.... short head of the biceps.

The great sciatic nerve divides about midway down the thigh into two branches, the *tibial* and *peroneal*, the former being named *popliteal* till it reaches the leg, and appears to be the proper continuation of the sciatic nerve.

The *popliteal nerve* passes down in the popliteal space, under the fascia, but superficially to the artery and vein; after passing the joint it rests on the popliteus muscle, under cover of the gastrocnemius, then crosses the posterior tibial artery and descends on its outer side, and is here properly named posterior tibial nerve; it then passes down with the artery, and in the sole of the foot divides into external and internal plantar nerves.

The branches given off by this nerve are:

Muscular twigs in its course.

A long branch given off in the popliteal space, (named *communicans tibiæ*,) descends between the two heads of the gastrocnemius, then over its posterior surface, running downwards to the outer border of the tendo achillis; it accompanies the saphena minor vein, and about the middle of the leg unites with a similar branch sent off from the peroneal nerve. This external *saphenous* nerve passes behind the outer ankle to the dorsum of the foot, where it divides into filaments, including the fourth and fifth metatarsal nerves, which extend to the digital phalanges. In its course down the leg it gives filaments which pierce the fascia and become subcutaneous.

The posterior tibial nerve, in its course down the leg, supplies filaments to the muscles in its immediate proximity, viz. the plantaris, gastrocnemius, solæus, tibialis posticus, and long flexors of the leg; and lower down gives filaments to the ligaments of the ankle, bursæ and fascia about the tendoachillis.

In the hollow of the foot this nerve gives off a filament to the integuments of the sole, and then divides into external and internal plantar nerves.

The *internal plantar nerve*, the larger of the two, takes the course of the internal plantar artery, gives branches to the abductor pollicis, flexor brevis digitorum, and accessorius, and divides into four filaments, very like the median in the hand; one branch, the smallest, passes to the inside of the great toe, the three others bifurcate to supply the opposed sides of the first, second, third, and fourth toes, giving filaments to the lumbricales and interossei muscles; the fourth nerve gives off a filament to communicate with the superficial branch of the external plantar nerve.

The *external plantar nerve* runs forwards between the flexor brevis and accessorius, in its course giving a branch to the abductor minimi digiti; it then divides into a superficial and deep branch. The *superficial* branch gives off a filament to the outside of the little toe, and then runs in the space between the fourth and fifth toe, giving a communicating filament to the fourth terminating branch of the internal plantar nerve, and afterwards separates into two filaments, to supply the opposed sides of the fourth and fifth toes.

The deep-seated branch runs close upon the metatarsal bones, supplying filaments to the interossei, flexor brevis pollicis, and transversalis pedis muscles.

The *peroneal* or *fibular* nerve, one of the branches of the great sciatic, in its course is inclined outwards, and descends between the biceps and outer head of the gastrocnemius, to reach the head of the fibula; a little below this it winds round the neck of the bone and divides into two branches, the *anterior tibial* or *interosseous*, and the *musculo-cutaneous;* the latter, in its direction, appears to be the continuation of the nerve, and descends between the peronæus longus and extensor digitorum longus, giving branches to them in its course. About the middle of the leg it escapes from between the muscles and descends between the extensor muscles and fascia, and divides into two branches.

The *external* branch descends and passes in front of the outer ankle, reaches the dorsum of the foot, and gives off three filaments, one to supply the dorsum of the little toe and outside of the foot; another passes between the fourth and third toes, supplying both, and a third is distributed between the second and third toes.

The *internal* branch goes to supply the inner border of the foot, and gives filaments to the upper surface of the first and second toes.

The branches of the peroneal, in its course downwards, are one in the popliteal space, to the short head of the biceps, terminating in the ligaments on the outside of the joint,—a branch which descends between the gastrocnemius externus and fascia, and gives off filaments to ramify on the outside of the leg,—and one which unites with the superficial branch of the posterior tibial nerve, to form the external saphenus nerve.

The *anterior tibial* or *interosseous nerve*, directly after its separation from the other branch of the peroneal, winds forwards and inwards between the fibula, the peroneus longus, and extensor communis, to which it gives filaments: it then arrives at the interosseous ligament and accompanies the anterior tibial artery, lying to its outer side, but lower down, rather in front of it, in which position it passes under the annular ligament to the dorsum of the foot. In its descent it gives filaments to the adjacent muscles, and on the foot divides into two branches:

One supplying the extensor brevis and the interossei and communicating with the peroneal nerve.

The other passes to the first and second toes.

SYMPATHETIC NERVE.

The sympathetic nerve (or nerves, as there is a similar structure on each side of the body,) was formerly called the great intercostal nerve, and was described as commencing in the cavernous sinus, by filaments from the fifth and sixth cerebral nerves. It is now viewed as a separate nervous system, named *ganglionic*, and is described as consisting of a series of ganglia, or nervous centres, connected together by filaments, and communicating in various parts with filaments derived from the cerebro-spinal nerves. From its apparent functions it is called the nerve of organic life. The ganglia are found in five regions of the body; namely, the head, neck, chest, abdomen, and pelvis, and are named accordingly.

The *cranial* ganglia are the *ophthalmic*, *spheno-palatine*, *otic*, *ganglion* of *Cloquet*, *submaxillary*, *carotic*, and a disputed one upon the arteria communicans, named *ganglion* of *Ribes.*

The cervical ganglia are three;

The dorsal, eleven;

The lumbar, five;

The sacral, four or five on each side, with an azygos ganglion near the coccyx.

The *ophthalmic* or *lenticular* ganglion is situated within the orbit between the optic nerve and external rectus muscle, and midway between the entrance of the optic nerve and the sclerotic coat. It is small, and is imbedded in a large quantity of fat.

The filaments from it are,

Anteriorly, fifteen to twenty, named ciliary; they pass forwards, perforate the sclerotic coat at its posterior part, run forward between the sclerotic coat and choroid, and part of them pass into the iris; the greater number are lost in the ciliary ligament.

Posteriorly, at the upper angle, a filament to the nasal nerve of the fifth.
at the inferior angle, a filament to the inferior division of the third cerebral nerve.
a third filament passes backwards to reach the carotic plexus.

The *spheno-palatine*, or *Meckel's* ganglion, is situated in the pterygo-maxillary fossa, having, in front, the tuberosity of the superior maxillary bone; behind, the roots of the pterygoid processes; internally, the palate bone and spheno-palatine foramen; and externally, the soft parts filling up the fossa. The branches of this ganglion are ascending, descending, internal, and posterior.

The *ascending*, or superior, are usually two, and very large; they unite with the superior maxillary nerve.

The *descending* are the palatine nerves, three in number. The *great palatine* nerve descends in the great palatine canal, and emerges at the posterior palatine foramen, from which it runs forward beneath the arch of the palate, as far as the foramen incisivum, where it communicates with Cloquet's ganglion. In its course it gives filaments, through the nasal plate of the palate bone, to the pituitary membrane of the nose, filaments to the velum palati, tonsil, and soft parts of the palate and gums.

The *middle palatine* descends parallel with the former, in a distinct canal, and is distributed to the soft palate and tonsil.

The *small palatine*, posterior to the two others, supplies the tonsil and soft palate.

The *internal*, or spheno-palatine, passes into the nasal fossæ, through the spheno-palatine foramen, by three or four filaments. They ramify upon the spongy bones, but one branch passes down upon the septum of the nose, runs through the ductus incisivus into the anterior palatine foramen, and communicates with Cloquet's ganglion. It is called the naso-palatine nerve, or nerve of Cotunnius.

The *posterior* branch is the *vidian*. It runs backwards through the vidian canal, and, having reached the foramen lacerum medium, divides into two branches, the *carotic* and *petrous*. The carotic branch runs down to the carotid artery, uniting with the plexus on this artery, and is thus connected with the first cervical ganglion; the petrous branch perforates the cartilage, filling up the foramen lacerum, and then runs beneath the dura mater, towards the foramen innominatum, which it enters; soon after its entrance, it unites with the portio dura, and runs with it along the aqueduct of Fallopius to its inferior extremity, where it leaves the other nerve; it then perforates the petrous bone and gets into the tympanum, running between the long crus of the incus and handle of the malleus (hence called *chorda tympani*), and emerges at the fissura glaseri; it then descends to the inner side of the lower jaw, communicating with the gustatory, and is ultimately distributed to the submaxillary ganglion.

Cloquet's ganglion, or naso-palatine, is situate in the anterior palatine canal, or foramen. It receives, superiorly, the naso-palatine nerve; inferiorly, a filament from the great palatine nerve; and sends off two or three twigs to the mucous membrane, on the anterior surface of the hard palate.

The submaxillary ganglion, or plexus, is small, and has a plexiform appearance. It rests upon the submaxillary gland. It communicates with the following nerves:

Posteriorly, with the vidian.
Superiorly, with the gustatory.
Inferiorly, it gives off filaments to accompany the Whartonian duct.

The *otic* ganglion, first minutely described by Arnold, is seated at the base of the skull, very near to the foramen ovale, and to the inner side of the third division of the fifth pair; internal to it is the Eustachian tube, and circumflexus palati; posteriorly, the middle meningeal artery. It communicates, by small filaments, with

the third division of the fifth pair, at its exit from the foramen ovale;
the pterygoid nerve;
the tympanic branch of the glosso-pharyngeal nerve, by a minute petrous twig.

It appears to give off

a filament to the tensor tympani muscle;
to the tensor palati;
to the anterior auricular nerve.

The *ganglion* of *Ribes* is situated upon the anterior arteria communicans, receiving filaments from the carotic plexus, and thus becomes a medium of connexion between the two ganglionic nerves of each side of the body. Its existence is disputed by some anatomists.

The *superior cervical ganglion* extends from the foramen magnum to the second or third cervical vertebra; it is generally more than an inch in length; oblong in its figure, and of considerable size. The branches from it are the following:

Ascending,	to communicate with the carotic plexus in the carotic canal.
External,	to the cervical nerves.
Internal,	to the pharynx, entering into the pharyngeal plexus.
Anterior	to unite with the par vagum, glosso-pharyngeal, lingual and facial nerves, and fialments named nervi molles, which accompany some of the branches of the external carotid; namely, the superior thyroid, lingual, labial, and ascending pharyngeal.
Descending,	to the second ganglion: and filaments to form the superficialis cordis.

The *middle cervical ganglion* is very small, and sometimes wanting on the left side. Its situation is upon the fifth cervical vertebra. It gives filaments to the superior and inferior ganglia, to the cervical nerves, the thyroid gland, superior thyroid artery, and parts adjacent, and sends off the middle cardiac nerve.

The *inferior cervical ganglion* lies upon the transverse process of the last cervical vertebra, and neck of the first rib, behind the vertebral artery, It gives off filaments to the middle cervical and superior thoracic ganglia, branches to unite with the axillary plexus, filaments to accompany the vertebral artery, which form the vertebral plexus, and run up as far as the base of the skull, communicating in their course with all the cervical nerves: it gives also filaments to the pulmonary plexus, and sends off the inferior cardiac nerve.

The *cardiac* plexus, destined for the supply of the heart, is formed by the cardiac nerves of the cervical ganglia, and branches from the nervus vagus and recurrent nerves. It is placed around the aorta, the greater portion being somewhat above it, and between it and the trachea; the other portion, just below the arch, and rather on its anterior aspect, resting somewhat upon the pulmonary artery. This portion has been named cardiac ganglion. The branches from this plexus are the following:

Some going to the pulmonary plexus;
Some to the anterior part of the aorta;
Many follow the course of the coronary arteries, and are called coronary plexuses; namely, right or anterior, and left or posterior. They follow the arteries, and send filaments into the substance of the heart.

The *thoracic* ganglia, eleven in number, lie upon the heads of the ribs, and are connected together by one or two small filaments; they then give off branches to unite with the intercostal nerves. The superior five ganglia give off anterior filaments to the trachea, œsophagus, and aorta, and contribute to form the pulmonary, cardiac, and thoracic plexuses. The anterior branches, from the sixth to the ninth, inclusive, unite to form the splanchnicus major; and similar branches from the tenth and eleventh ganglia form the splanchnicus minor. These nerves descend by the side of the vertebræ, pierce the crura of the diaphragm separately, and enter the abdomen. The splanchnicus major passes to the semilunar ganglion of each side, and the splanchnicus minor to the renal plexus.

The *semilunar* ganglion of each side is situated close to the cœliac axis, around which the fibres interlace, and with filaments from the nervus vagus, phrenic, and splanchnicus minor, constitute the great solar plexus. From this, branches pass off to accompany the contiguous arteries, and are named so many plexuses: they are,

Phrenic, to the crura, and broad part of the diaphragm running with the arteries.

The *coronary*, or *stomachic*, accompany the coronary artery to the stomach, distributed upon both its surfaces.

The *hepatic* plexus, accompanying the vessels into the transverse fissure of the liver; some of its filaments pass to the pylorus, others along with the gastro-duodenal artery. This plexus unites with filaments from the nervus vagus.

The *splenic* plexus, accompanying the splenic artery, and sending filaments with the vasa brevia to the great end of the stomach.

The *aortic* plexus, a continuation, as it were, of the solar plexus upon the aorta, with branches from the lumbar ganglia, may be said to send off the *superior* and *inferior mesenteric plexuses*, to accompany the corresponding arteries.

The *splanchnicus minor*, with other filaments from the sympathetic, forms the renal plexus, and this sends off numerous filaments into the kidney, accompanying the arterial branches; and gives off inferiorly some filaments to accompany the spermatic artery, and which constitute the spermatic plexus.

In the abdomen we find the *lumbar* ganglia, four or five in number, by the sides of the lumbar vertebræ, and to the inner edge of the psoas muscle. They are connected together by filaments, and are connected with the lumbar nerves and plexus, and send filaments anteriorly to the aorta, which enter into the composition of the abdominal, aortic, and lumbar plexuses.

The *sacral ganglia* are four or five on each side, with an azygos terminating one; they unite together by filaments, and communicate with the contiguous spinal nerves. Anterior filaments from them, and also from the lowest lumbar ganglion, form the hypogastric plexus, which supplies nerves to the adjacent viscera; viz. the bladder, vesiculæ seminales, uterus, vagina, and rectum.

THE EYE.

The eye is placed within a bony cavity, named the orbit.

Each *orbit* is formed by seven bones; and as three of them are common to both orbits, there are eleven bones only entering into the two. The orbit is pyramidal in form, with the base anteriorly, and directed a little outwards; the apex backwards and inwards. Probes passed through the axis of each orbit, into the cranium, will pass through the foramen lacerum orbitale superius, and meet upon the sella turcica. The roof of the orbit is formed by the frontal and ala minor of the sphenoid bone; the floor by the malar, superior maxillary, and palate bone; the outer wall by the malar and sphenoid; and the inner wall by the nasal process of the superior maxillary, the ethmoid and frontal bones.

The orbit contains the globe of the eye, with numerous nerves, vessels, fat, and part of the lacrymal apparatus.

In dissecting the orbit, and removing its roof, the nerves will be found in the following order:

Fourth pair.
Frontal of the fifth.
Superior division of the third.
External to these, and nearly on the same plane, the lacrymal of the fifth.
The sixth pair.
Inferior division of the third.

The trunk of the ophthalmic artery, at first below and to the outer side of the optic nerve, soon after crosses over, to get to its inner side. The ophthalmic vein passes backwards between the origins of the external rectus.

The parts named appendages of the eye, are the eyebrows, eyelids, and part of the lacrymal organs.

The *eyebrows* consist of the integuments covering the supraorbital ridge of the frontal bone on each side. They contain adipose tissue and fibres of the occipito-frontalis and corrugator supercilii muscles, and are studded with hairs, extending in an arched direction from near the root of the nose to a little beyond the outer canthus of the eye.

The *eyelids* are two thin curtains covering the eye, and are superior and inferior. They consist of common integument externally, of mucous membrane internally, containing between them some very loose cellular tissue, which causes the lids to swell very rapidly from any effusion of blood or serum; the orbicularis palpebrarum; the tarsal cartilages; and in the upper lid, fibres of the levator palpebræ superioris. Their points of union are called the external and internal canthus. Along the internal surface, near their edges, are numerous glandular bodies, called the meibomian glands or follicles, and at their margins a row of stiff hairs, called cilia or eyelashes. Near the internal commissure, on each eyelid, there is an angular projection, presenting a little orifice, named punctum lacrymale. These orifices are surrounded by a fibro-cartilaginous ring, which serves to keep them patulous, and to allow the tears to pass from the surface of the eye into the lacrymal sac.

The tarsal fibro-cartilages differ in the two lids. The upper one is semilunar in form, with its convex thin edge uppermost; it is kept in its place by palpebral ligaments, connecting it internally with the tendo-oculi, superiorly and externally with the periosteum of the orbit. The lower fibro-cartilage is smaller, and of nearly equal thickness in its whole length, and is attached at its extremities like the upper one.

The *meibomian glands*, or sebaceous follicles, are more numerous in the upper than under eyelid: in the upper one there are about forty; in the lower one, half the number. They are arranged in vertical rows, and open at the edges of the lids. The secreted matter from them prevents the eyelids from sticking together, and in some measure prevents the tears from escaping over the edges of the lids.

Near the internal canthus are also seen two other bodies, the plica semilunaris and the caruncula lacrymalis.

The *plica*, or *valvula semilunaris*, is a fold of mucous membrane of a triangular form; its base is concave towards the centre of the eye, its apex pointing to the inner canthus; it appears like a third eyelid, or rudiment of the membrana nictitans in the owl, eagle, &c.

The *caruncula lacrymalis* is a small fleshy body of a red colour, composed chiefly of mucous follicles, studded with small hairs on its surface.

The lacrymal apparatus consists of the lacrymal gland and tubes, the puncta and lacrymal canals, the lacrymal sac, and nasal duct.

The *lacrymal gland* is situated at the upper and outer part of the orbit, resting against the lacrymal fossa of the frontal bone; it is from half an inch to an inch long, and about half an inch broad, composed of two lobes, consisting of a number of lobules like a conglomerate gland; from it seven or eight little tubes proceed, which open on the under surface of the upper eyelid, near the external canthus. The tears then pass along the surface of the eye towards the puncta lacrymalia, which they enter, and from which two canals are extended to the lacrymal sac.

The canals leading into the sac differ in their direction; the upper one forms an angle in its middle course, looking upwards; the lower one is nearly straight, and if curved, is so downwards: they are thus concave towards each other, and open close together, and sometimes by a single aperture into the sac.

The *lacrymal sac* is an elongated reservoir, situated behind the palpebral ligament, in a fossa formed by the os unguis and the nasal process of the superior maxillary bone, opening inferiorly into the nasal duct. It is lined by mucous membrane, and by a thin fibrous layer forming a periosteum.

The *nasal duct,* a continuation of the lacrymal sac of the nose to the inferior meatus, is from half an inch to three quarters in length. Its direction is downwards, backwards, and a little outwards. Its bony parietes are the os unguis, the superior maxillary bone, and the inferior spongy bone. It opens into the inferior meatus of the nose, having a fold of mucous membrane in front of it.

The *globe* or *ball* of the eye is composed of *membranes* or *coats, humours, vessels,* and *nerves.*

The *membranes* of the eye are the *tunica conjunctiva, sclerotica, cornea, iris, retina,* the *hyaloid, capsule* of the *lens,* and *membrane* of the aqueous humour.

The *tunica conjunctiva* is a delicate mucous membrane, reflexed over the anterior third of the globe of the eye, and lining the internal parts of the eyelids; it is a continuation of the skin, and also of the mucous membrane of the nasal fossæ; it is most vascular where it lines the lids, less so upon the sclerotica, and least upon the cornea.

The *sclerotic coat,* so named from its hardness, is fibrous in structure, and continuous with the dura mater, through the medium of the optic nerve, covering about four fifths of the globe of the eye; it is thickest posteriorly, thinner at the sides, but thick again where it unites with the cornea; externally, it is in apposition with the muscles, vessels, lacrymal gland and nerves; internally, with the choroid coat. It is perforated laterally and posteriorly by the ciliary nerves and vessels; and posteriorly, but internally and inferiorly, to the axis of the eye, by the optic nerve, which enters by several orifices in a cribriform manner. The tendinous expansion of the recti muscles upon the anterior part of the sclerotica has obtained the name of *tunica albuginea.*

The *cornea* is the transparent covering in front of the eye, about six lines in diameter, but which is slightly greater in the transverse direction; by its outer margin, which is bevelled off only in front, it is attached to the sclerotica, which slightly overlaps it, on account of which anatomists, not very correctly, say that the cornea fits into the sclerotica like a glass into a watch-case: externally, it is covered by the conjunctiva: internally, it is in contact with the membrane of the aqueous humour. It is convex anteriorly, concave posteriorly, and composed of several lamellæ connected by cellular substance, with a thin serous fluid between them.

The *choroid membrane*, situated between the sclerotica and retina, is essentially vascular. It extends from the optic nerve to the ciliary ligament; near its anterior margin, it is thrown into folds or processes, which lie upon the edge of the lens and anterior portion of the vitreous humour: these are called ciliary striæ, or processes. On its outer surface are seen the ciliary nerves and long arteries; next to them the veins of the choroid, called vasa vorticosa; internally to them the short ciliary arteries, which, by subdividing, form a beautiful network, named tunica Ruyschiana, and next to these a delicate lamellated membrane, named *tunica pigmenti*, which secretes on its inner surface the pigmentum nigrum, in some animals termed the tapetum.

The *ciliary striæ*, or processes, are very numerous, from seventy to eighty in number, alternately long and short, and conjointly named corpus ciliare. They are somewhat triangular in shape, and having pigmentum nigrum deposited between them, when removed from the vitreous humour, they leave a radiated appearance.

The *retina*, as it is termed, consists of three membranes, the outer of which, in apposition with the choroid, is the tunica Jacobi; the middle one, the real expansion of the optic nerve, the tunica nervosa; the inner one is the tunica vasculosa retinæ. The extent of the retina anteriorly, is not quite clear, some say, and amongst them Cruveilhier, that it only proceeds as far as the posterior edges of the ciliary striæ; others, that it passes as far as the crystalline lens.

The *tunica Jacobi* is an extremely delicate (serous?) membrane, composed of two layers, according to the researches of Mr. Dalrymple, and forming a shut sac.

The *tunica nervosa*, the expansion of the optic nerve, is pulpy, and terminates at the edge of the ciliary processes.

The *tunica vasculosa* contains several minute branches from the arteria centralis retinæ.

In the centre of the back part of the retina, in the axis of the globe of the eye, a yellow spot is observed, called the limbus luteus, with a fancied orifice, called foramen centrale of Sömmering. This is produced by a deposit of yellow substance; and the membrane being puckered up into a fold, causes the appearance of a dark spot or orifice in the centre.

The *iris* is a circular membrane, attached by its outer border to the ciliary ligament, with a central aperture, called the pupil. Its anterior surface presents various colours in different individuals, depending upon the quality of the deposit on its posterior part, named the uvea, similar in nature to the colouring matter of the choroid coat. It separates the cornea from the lens, and forms a partial septum between the chambers of the eye.

In structure it appears to be fibrous, and, according to some, muscular. On the anterior surface two circles may be observed, the external one, named *annulus major*, is paler, and consists of fibres radiating from the circumference towards the centre; the inner fibres run circularly and form the *annulus minor*. On the posterior surface of the iris, the fibres pass straight from the circumference towards the pupillary margin.

The pupil of the fœtus, up to nearly the seventh month, is filled up by a membrane, called the membrana pupillaris: this is supposed to be formed by a meeting of the membranes lining the two chambers of the eye, but seems more like a continuation of iris, which is afterwards absorbed, in consequence of the pressure produced by the evolution and growth of the lens.

The space between the anterior surface of the iris and the cornea is called the *anterior chamber of the eye*. It is lined with a membrane which cannot be very clearly demonstrated upon the anterior surface of the iris. A similar space exists between the posterior surface of the iris and lens, termed posterior chamber. The anterior chamber is about a fifth larger than the posterior.

The iris is supplied with blood by the long, short, and anterior ciliary arteries: by meeting and anastomosing at the external part of the iris, they form the *larger arterial circle*: and again, by anastomosing near the pupillary margin, they constitute the *circulus arteriosus minor*: its nerves are derived from the lenticular ganglion and nasal branch of the fifth; its veins empty themselves into the vasa vorticosa.

The external edge of the iris, by uniting with the choroid and sclerotic coats, forms a grayish circle, named the ciliary circle or ligament. The ciliary ligament is described by some as formed by the union of the cornea, choroid and sclerotic coats. From its gray pulpy appearance and nerves terminating in it, some have supposed it to be a nervous ganglion.

Between the ciliary ligament and sclerotic coat, a narrow circular canal may be found, called the canal of Fontana.

Humours of the Eye. The aqueous humour contained within the anterior and posterior chambers is secreted by its proper membrane. In quantity it is about three drops; its use is to properly distend the cornea, to allow free motion of the iris, and to act on the direction of the rays of light as they pass through it.

The *crystalline lens* is a transparent body, situate behind the iris, and in front of but partially imbedded in the vitreous humour. It is composed of concentric lamellæ, softest on the outside, and contained in a capsule, between which and the lens there is a little fluid, named the liquor Morgagni.

It is doubly convex: the anterior portion represents a small segment of a large sphere; the posterior one a larger segment of a smaller sphere, consequently it is most convex posteriorly. It is also covered by the hyaloid membrane, which at its edge separates into two layers, of which one passes in front the other behind the lens. By this separation a space is left at the edge of the lens, known as the canal of Petit; when inflated by a blowpipe it has a vesicular appearance.

The vitreous humour, or *corpus vitreum*, which fills up the two posterior thirds of the eye, is perfectly transparent. It is contained in a number of cells, formed by processes of the hyaloid membrane, which also gives it a general covering. It is penetrated by branches of the arteria centralis retinæ, and is excavated anteriorly for the lodgement of the crystalline lens.

THE EAR.

The ear, as commonly understood, consists of external and internal parts.

The parts of the external ear are the auricula and external auditory passage or meatus; the parts of the internal ear are the tympanum and labyrinth.

The *auricula*, or outer ear, is composed of common integument, fibro-cartilages, muscular fibres, vessels, and nerves. The upper expanded portion is named the *pinna*, the lower small part the *lobe* or *lobule*, which is devoid of fibro-cartilage and muscle.

The prominent ridge forming the outer part of the pinna is named the *helix;* the bifid projection within it is named *antihelix;* the nipple-shaped prominence just in front of the meatus externus is the *tragus;* a small one behind and opposite to it, the *antitragus.* The depression, or groove, between the helix and antihelix is the *fossa innominata*, that between the ridges of the antihelix is the *fossa navicularis*, and the deep fossa below it is the *concha.* The posterior surface of the concha is called the *dorsum* of the ear.

The outer ear is kept in its situation by fibrous bands, which attach it to the zygoma, the mastoid process, and temporal aponeurosis. It is moved by three muscles, the *anterior auris*, *retrahentes*, and *attollens aurem.* There are also delicate muscles proper to the pinna of the ear, for the motion of separate parts, but so small as to be discovered with some difficulty; they are rudiments of like parts found in animals, and are the following:

Helicis major.
...... *minor.*
Tragicus.
Antitragicus.
Transversus auriculæ.

And two others described by Mr. Tod, viz.

Obliquus auris.
Contractor meatus.

The *meatus auditorius externus*, or external auditory passage, extends from the concha to the membrana tympani. It is partly formed of cartilage and integument, partly of the latter and bone. The lining integument is also reflexed upon the membrana tympani. Its direction is inwards and slightly forwards, arching a little superiorly, thus presenting a slight concave direction inferiorly. Its length is about an inch, but is somewhat longer inferiorly, in consequence of the oblique position of the membrana tympani. Its broadest part is external, the narrowest in the middle. The integument lining this meatus is studded with a number of ceruminous glands, which secrete the peculiar thick fluid called wax of the ear, and at the outer part has a number of hairs.

This passage is separated from the internal ear by the membrana tympani.

The *membrana tympani* is nearly circular, attached by its circumference to a bony ring. It consists of three layers, the outer one a continuation of the common integument, the inner one continuous with the mucous membrane of the tympanum; the middle one is fibrous, and is the proper membrane. Its fibres converge from the circumference to the centre. It is concave externally, convex internally. Its direction is oblique, as it looks downwards, outwards, and forwards; to the centre of it, internally, the long handle of the malleus is attached.

The *tympanum,* or drum of the ear, is a narrow cavity, lined with mucous membrane, continuous with that from the Eustachian tube, bounded externally by the membrana tympani, posteriorly by the mastoid process and cells, and internally by the labyrinth. On its inner wall, about the centre, a prominence is seen, called the *promontory;* above this is a foramen, closed by membrane in the recent state, named *fenestra ovalis*, which communicates with the vestibule. Below the promontory, and more concealed by it, is a round aperture, likewise closed in the recent state by membrane, called *fenestra rotunda;* it is in relation with the scala tympani. Along the posterior wall, behind the promontory, we find a little bony projection, named the pyramid: it presents a little orifice at its apex, which transmits the tendon of the stapedius muscle, the body of which is lodged in the bone; beneath this, and behind it, is a little foramen, which transmits the chorda tympani; superiorly and posteriorly is the opening from the mastoid cells.

Along the anterior part of the tympani we meet with the glaserian fissure, which gives lodgement to the processus gracilis of the malleus, and passage to the chorda tympani and tendon of the laxator tympani muscle, a minute artery and vein. Anteriorly and internally we observe the orifices for the Eustachian tube, and tensor tympani muscle.

Within the tympanum is a chain of small bones, named *ossicula auditus.* They are the malleus, incus, orbiculare, and stapes.

The *malleus* (a hammer), in relation with the membrana tympani, consists of a head, neck, and processes.

The *head* articulates with the incus; the *neck* is between this and the processes; the *manubrium* (handle) is a long process, connected by its extremity with the membrana tympani. The processus brevis is external, passes from the neck at a right angle, and rests against the membrana tympani. The processus gracilis proceeds from the neck, forwards and downwards, and is inserted by its point into the glaserian fissure.

The *incus* (an anvil) may be divided into a body and processes. The body is anterior, and is articulated at its upper part with the head of the malleus. Its short crus, or process, is directed backwards, and retires into the mastoid cells; its long process, or crus, passes forwards, downwards, and inwards, terminating in a rounded point, which has been named as a separate bone, the *os orbiculare*, by which it is articulated with the stapes.

The *stapes* (a stirrup) is said to consist of a base, processes, a neck, and head. The *head* is articulated with the incus; the *neck* has the stapedius muscle attached to it; the *processes* pass from the neck to the base, and have a delicate membrane filling up the space between them; the *base*, of an oval form, fills up or occupies the opening named *fenestra ovalis.*

These bones admit of some motion, which is influenced by some minute muscles, the smallest in the body. They are four in number:

The *Tensor tympani:*

Or. Upper surface of the cartilage of the Eustachian tube and petrous bone.
Ins. The processus brevis of the malleus.

Laxator tympani:

Or. Spinous process of sphenoid bone.
Ins. Processus gracilis of the malleus.

Laxator tympani minor:

Or. The bony circumference of the membrana tympani.
Ins. Manubrium of malleus, near the short process.

Stapedius:

Or. Tube of the pyramid.
Ins. Neck of the stapes.

The *Eustachian tube* is partly formed of bone and partly of cartilage. The cartilaginous portion forms about two thirds of it. It is narrowest about the middle third, broadest at its anterior part. Its direction from the ear is forwards, inwards, and a little downwards. It opens opposite the posterior part of the inferior spongy bone. The bony portion is separated from the tensor tympani muscle by a thin bony partition, called *processus cochleariformis.* The cartilage does not completely surround the tube, but is deficient at the inferior external part, which is filled up by a fibrous substance.

The *labyrinth* consists of the vestibule cochlea and semicircular canals. It is lined with a delicate membrane, which is bathed by a thin fluid named aqua labyrinthi, and contains the ramifications and expansions of the auditory nerve, thus constituting the principal part of the organ of hearing.

The *vestibule* is a cavity somewhat larger than a grain of pearl barley. It is nearly filled with the expansion of the portio mollis, is lined with a delicate membrane, between which and the nerve is the liquor cotunnii. Its boundaries are:

Anteriorly, the cochlea.
Posteriorly, the semicircular canals.
Internally, the lamina cribrosa, for the portio mollis.
Externally, the osseous plate forming the promontory.
Superiorly, the bone, containing the aqueduct of Fallopius.

The openings into it, in the dry bone, are the fenestra ovalis, externally; five openings from the semicircular canals, posteriorly; one from the scala vestibuli, anteriorly; the foramina for the auditory nerve, internally; and from the posterior and external part a foramen which transmits a small vein, and is named aquæductus vestibuli.

The *cochlea* is situated in front of the vestibule, in the hardest portion of the petrous bone. It is named from its resemblance to the spiral tubes of a shell. It may be described as a spiral bony tube, which makes two turns and a half round an axis or pillar, named modiolus. This tube is separated, by a delicate lamella in the recent state, into two distinct tubes, which are named the scala tympani (the staircase of the tympanum) and scala vestibuli, in consequence of one opening into the vestibule, the other communicating with the tympanum at the fenestra rotunda, with the intervention of a delicate membrane. The lamella is formed of bone towards the modiolus, and does not quite extend to the top of the tube; the rest is membranous, and extends as far as the cupola, which is the extreme point where the two scalæ communicate.

The base of the modiolus is opposite to the entrance of the portio mollis from the internal auditory meatus, and is here perforated for the little nervous filaments and vessels: the passage in the modiolus expanding at the top is called the infundibulum.

Near to tee point where the scala tympani communicates with the fenestra rotunda, a small foramen exists, which transmits a vein, and is named *aquæductus cochleæ.* It opens into the lateral sinus near the jugular fossa.

The *semicircular* canals are three in number, and, from their direction, are named superior or *vertical*, external or *horizontal*, and posterior or *oblique ;* they are situated in the petrous bone, not so deeply embedded as the cochlea, and each of them forms rather more than half a circle; they are lined with a delicate membrane, and contain the pulpy expansion of the portio mollis, in a sheath, with a little fluid intervening between this and the canals. They open by each extremity into the vestibule; but, as the vertical and posterior canals unite together by their contiguous superior extremities before communicating with the vestibule, there are only five, instead of six, openings.

The *meatus auditorius internus*, is a bony canal in the posterior surface of the pars petrosa, giving passage to the portio mollis, portio dura, and an artery which runs somewhat between the two nerves. At the bottom of this canal a little bony ridge is seen, separating it into two parts, the superior smaller, and the inferior cribriform plate. Through the upper opening the portio dura passes; through the lower, the portio mollis and the artery.

The superior passage, or tube, is the aqueduct of Fallopius; it passes upwards and outwards, then downwards and outwards, and then backwards and downwards; at first above the cochlea, it then runs over the roof of the tympanum and terminates at the foramen stylo-mastoideum. It conveys the vidian nerve and portio dura, the latter of which in its course gives filaments to pierce the bone, and supply the tensor tympani and stapedius muscles.

The auditory nerve at the bottom of the meatus divides into numerous filaments; some pass into the foramina of the modiolus, and in their passage perforate its walls, and arrive at the lamina spiralis, and walls of the scalæ, upon which they are spread out in the most delicate manner. A second set in the vestibule expand almost to fill up this cavity, and receive an investment from its membrane, which has been named sacculus vestibuli. The third series mount up over the former, and enter the semicircular canals. On entering them, the nerves appear to expand into a pulpy mass, which almost fills up the tubes; they are supported by the liquor cotunnii. The vidian nerve is said by some anatomists to supply motor filaments to all the muscles of the internal ear.

The arteries, which are very delicate, are, first, the branch from the basilar or posterior cerebral, which enters by the lamina cribrosa, and ramifies in the labyrinth; second, a *stylo-mastoid* branch from the posterior auricular, enters the tympanum, supplies minute branches to it, the mastoid cells and labyrinth sometimes forming an arterial circle round the membrana tympani by uniting with the artery which enters by the fissura glaseri; third, the tympanic branch given off from the internal maxillary artery—this enters through the fissura glaseri, ramifies in the tympanum, and anastomoses freely with the stylomastoid branch. The veins corresponding with the last-named arteries take a similar course; but those of the labyrinth terminate in the (improperly named) aqueducts of the vestibule and cochlea, which convey the blood to the lateral sinuses.

LARYNX, TRACHEA, AND BRONCHI.

The *larynx* is composed of cartilages, numerous ligaments, muscles and lining mucous membrane, with its arteries, veins, nerves, and absorbents.

It is situated in the front and middle of the neck, anterior to the pharynx; connected with the os hyoides superiorly, with the trachea inferiorly, and bounded laterally by muscles and the large vessels of the neck.

It is nearly a third larger in the male than in the female.

The thyroid cartilage, which is the largest, is placed anteriorly. It is formed by two lateral portions of a quadrangular shape, united anteriorly at an obtuse angle, where they form a projection, termed pomum Adami, most prominent in the male. At the superior posterior angle, on each side, there is a projecting portion, named superior cornu, which is attached by a lateral thyro-hyoid or round ligament to the os hyoides. There is frequently found in it a small portion of bony matter.

The inferior margin, convex in the centre, is connected by the crico-thyroid ligament to the cricoid cartilage. At the posterior inferior angle another projection is found, named the inferior cornu, which is connected with the cricoid cartilage by the lateral crico-thyroid ligament.

The cricoid cartilage is of the form of a ring, with its broadest or signet portion posteriorly. It lies beneath the thyroid cartilage, and above the first ring of the trachea. It is connected with the former by the crico-thyroid ligaments, and with the latter by a broad process of ligamentous substance.

Its superior margin inclines downwards and forwards, its inferior one is horizontal. On its posterior superior margin are observed four smooth articulating surfaces, the direction of which is upwards and outwards. The most internal articulating surface on each side receives the base of the arytenoid cartilage; the outer one, the inferior cornu of the thyroid cartilage. The posterior surface of the cricoid cartilage is furrowed by the crico-arytenoidei postici muscles. In old age this cartilage is frequently ossified.

The *arytenoid* cartilages are two in number, of a pyramidal figure, attached at their base by capsular ligaments to the upper edge of the cricoid cartilage.

They have a little cartilaginous appendage on the summit of each, named *corniculum laryngis*, which is attached by ligaments and a synovial capsule.

Their posterior surface is a little hollowed out, for the insertion of the transverse and oblique arytenoid muscles.

To their anterior surface, which is rather convex, and to the apex, ligamentous fibres are attached, which pass to the inside of the projecting part of the thyroid cartilage, and to the epiglottis.

These cartilages are sometimes ossified.

The *epiglottis* in texture is not strictly cartilaginous; it belongs rather to the fibro-cartilaginous tissue, known by the French as *tissu jaune*.

It is attached inferiorly to the internal surface of the thyroid cartilage by a strong elastic ligamentous substance.

It is somewhat oval, or is likened to an obcordate leaf, rather convex above, concave below, covered by mucous membrane, and studded with numerous mucous follicles.

It is kept in its situation also by ligaments, one extending from the base of the tongue, and likewise by two ligaments, which proceed from its sides to the arytenoid cartilages.

The ligaments of the larynx are by some considered to be seventeen in number. They are, three broad, four capsular, two round, four thyro-arytenoid, and four connected with the epiglottis.

The broad ligaments are

The thyro-hyoid, connecting the upper edge of the thyroid cartilage with the internal surface of the os hyoides. It is also named thyro-hyoid membrane.
The crico-thyroid.
The ligamentous substance between the cricoid cartilage and the first ring of the trachea.

The capsular ligaments are four. They are on each side.

Crico-arytenoid.
Crico-thyroid.

The two round ligaments extend from the superior cornu of the thyroid cartilage to the os hyoides on each side.

The thyro-arytenoid ligaments are superior and inferior on each side. The inferior only are really ligamentous, and form the true *chordæ vocales;* they pass from the base of the arytenoid cartilages to the inside of the angle of the thyroid. The superior, so styled, ligaments, are folds of mucous membrane, passing from near the apex of the arytenoid cartilages to the same point as the former. Between the two, on each side, is a fossa, named *sacculus laryngis*, or ventricle of Galen.

The four ligaments of the epiglottis are

Thyro-epiglottidean, really ligamentous.
Glosso-epiglottidean, a fold of mucous membrane.
Two aryteno-epiglottidean, also folds of mucous membrane.

The muscles connected with the larynx, and concerned in its motions, are, anteriorly, the *sterno-hyoid*, *sterno-thyroid*, *thyro-hyoid*, and *crico-thyroid;* posteriorly, the *crico-arytenoidei postici*, *arytenoideus transversus*, and *obliquus;* and laterally, *crico-arytenoidei laterales* and *thyro-arytenoidei.*

The arteries of the larynx are, the superior laryngeal, from the external carotid; and inferior laryngeal, from the subclavian.

The mucous membrane of this organ is studded with numerous follicles, some of which have obtained the name of glands; some of these aggregated just above the epiglottis, between it and the tongue, embedded in some fat, form the *epiglottidean gland*, from which small tubes pass through the epiglottis, and lubricate its under surface.

The nerves are chiefly from the pneumogastric.

The *trachea* extends on the mesial line of the neck, from the cricoid cartilage to the bronchi, from about the fourth cervical vertebra to opposite the third dorsal. It is covered anteriorly by the sterno-hyoid and sterno-thyroid muscles, and thyroid gland; posteriorly it is in contact with the œsophagus, which inclines to its left side; laterally it is bounded by the large vessels of the neck, the nervus vagus, and sympathetic nerve, and in the chest is crossed by the left vena innominata, the arteria innominata, and the arch of the aorta.

Its figure is that of a cylindrical tube, rather flattened posteriorly, and diminishing in capacity as it descends.

It is composed of from fifteen to twenty segments of cartilaginous rings, incomplete posteriorly, the space being filled up by a musculo-membranous substance: in the expanded state of the trachea the cartilages form two thirds of a circle; when it is contracted or collapsed, about three fourths. They are thickest in front, and differ from each other in depth and size: the largest are the first and last, the intermediate ones vary much; they are united together by perpendicular ligamentous fibres.

The substance which completes the rings posteriorly is truly muscular. The fibres are connected transversely with the edges or ends of the cartilaginous rings; longitudinally, they descend from the cricoid cartilage to the bronchi; behind these is a dense fibrous elastic structure, and between them there is a number of mucous glands. The lining mucous or bronchial membrane of the trachea is continuous from the upper part of the larynx to the minutest ramifications of the bronchi. It is always moist, soft, and elastic; is thinner than in the larynx, and gradually more so as it passes into the ramifications of the bronchi.

The *bronchi* are two in number, and are formed by the bifurcation of the trachea, opposite the third dorsal vertebra.

The right bronchus is larger than the left, and is shorter, reaching the lung on a line with the fourth dorsal vertebra. It passes outwards to the right side, under the arch of the vena azygos, behind the vena cava superior, in a less oblique direction than the left bronchus.

The left bronchus passes through the arch of the aorta, and then joins the left pulmonary artery and corresponding veins in the root of the left lung.

The structure of the bronchi is similar to that of the trachea. They divide and subdivide into numerous ramifications, till they appear to pass into a fine ligamentous tissue, the cartilage gradually disappearing, and finally terminating in forming the air-cells of the lungs.

THORACIC VISCERA.

The *thorax* is a conical cavity, bounded superiorly by the first rib, the clavicle and soft parts entering and passing out of the chest; inferiorly by the diaphragm; anteriorly by the sternum and cartilages of the ribs; laterally by the bodies of the ribs and intercostal muscles; and posteriorly by the spine and the angles of the ribs.

The parts which pass through the upper aperture, are the trachea, thyroid veins, arteria innominata, left carotid and subclavian arteries, right and left venæ innominatæ, the sterno-hyoid and sterno-thyroid muscles, nervus vagus, and recurrent nerve of each side, the œsophagus, the sympathetic nerves, and longus colli of each side, and the thoracic duct.

The contents of the thorax are the *lungs* and *pluræ*, the *heart* and *pericardium*, and the parts contained in the *anterior* and *posterior mediastinum.*

The *pleura* of each side is a smooth serous membrane, forming a shut sac: one portion, lining the inside of the ribs and the thickest, is called *pleura costalis;* the part reflexed over the lungs is named *pleura pulmonalis.* It is also reflexed upon the pericardium and diaphragm, on each side. Superiorly the pleura ascends into the neck, almost level with the fifth cervical vertebra, where it forms its cone behind the subclavian artery. By some anatomists a distinct fibrous membrane is described as existing between the ribs and the pleura, and by others a similar membrane between it and the lungs, forming a fibrous capsule for these organs.

This membrane is lubricated by a soft fluid; and the two portions are, during health, in constant apposition.

These oval bags, by meeting near the centre of the chest, form two triangular spaces, named the *anterior* and *posterior mediastinum.* Some anatomists add to these a third mediastinum, placing within it the heart, pericardium, and phrenic nerves.

The *anterior mediastinum,* separated superiorly from the posterior by the bifurcation of the trachea, the arch of the aorta and venæ innominatæ, contains the remains of the thymus gland, the origin of the sterno-hyoid and sterno-thyroid muscles, lymphatics from the surface of the liver, the internal mammary arteries and veins, and triangulares sterni muscles. Its base is formed by the sternum, its sides by the pleura of each side, and its apex by their meeting. Superiorly, this cavity extends into the neck; inferiorly, it communicates, through a triangular deficiency in the diaphragm, with the cellular tissue of the abdominal parietes.

The *thymus* gland, scarcely perceptible in the adult, is of a considerable size in the fœtus and young child; it is first observed about the fourth month of fœtal life, increasing till birth; after which it remains stationary, or increases slightly, till about the end of the first year, when it begins gradually to decrease. It consists of two elongated lobes, placed side by side in the anterior mediastinum. The structure of this body is like that of the thyroid; within it a cellular structure is observed, with sometimes a quantity of thick fluid. A duct is described by Sir A. Cooper, as proceeding from it, and opening into the vena innominata. It is very vascular, but the use of it is unknown.

The *posterior mediastinum* extends from the third to the tenth or eleventh dorsal vertebra. It contains the *œsophagus*, *aorta descendens*, the *thoracic duct*, the *par vagum* of each side, the *vena azygos*, some lymphatic glands and vessels, and the great *splanchnic nerves.* In the lower half of this space the *œsophagus*, inclined to the left side of the spine, is most anterior, and is accompanied by the par vagum; the right par vagum is rather behind, but the left is in front; beneath or behind the œsophagus is the aorta, a little on the left side of the spine. On the right of this is the vena azygos, and between these the thoracic duct.

The descending aorta escapes from the posterior mediastinum into the abdomen, through the aortic opening of the diaphragm, where it lies nearly in front of the vertebral column; it descends behind the heart and pericardium; to its left side is the left pleura; and more inferiorly the œsophagus; to its right, the thoracic duct.

The vena azygos enters the thorax through the aortic opening of the diaphragm, lying to the right of the aorta and the thoracicduct, ascends in the posterior medastinum to the right side of the spine, and behind the root of the right lung; it here receives most of the right intercostal veins, and the six inferior left intercostal veins, then hooks round the right bronchus, and terminates in the superior vena cava, as this vessel is about entering the pericardium.

The toracic duct ascends in the posterior mediastinum between the vena azygos, and the aorta as high as the sixth dorsal vertebra, it then passes behind the aorta towards the left side, ascends into the neck, then turns downwards, and terminates in the left subclavian vein, just as it unites with the internal jugular.

The great splanchnic nerves are formed, one on each side, by branches from the dorsal ganglia of the sympathetic, extending from the sixth to the ninth ; they enter the abdomen through the crura of the diaphragm, or sometimes along with the aorta.

The *lungs* are conical bodies, occupying the sides of the chest on each side of the mediastina. They are firmly attached to the heart by means of their large vessels, and to the trachea by the bronchi, which thus conjointly form the root of each lung. The reflexion of the pleura from the diaphragm to the lungs on either side is named by some pulmonary ligament.

They are invested by the pleura pulmonalis, which is more delicate than the membrane lining the ribs. The two layers of pleura are in close contact, having between them only a very minute portion of fluid to lubricate them in a healthy state, but no particle of air. If by accident or design an aperture is made into the bag of the pleura, the lung collapses from the atmospheric pressure, and the breathing is immediately impeded.

The colour of the lungs varies with the age. In the infant it is red ; about twenty, it is bluish ; and in more advanced age bluish gray, with some dark spots dispersed upon them.

The shape of the lungs is conical ; the apex projects a little above the first rib ; the base turned downwards, is concave, and rests on the upper surface of the diaphragm; they are flattened anteriorly, convex posteriorly ; the surface in contact with the pericardium is concave, particularly of the left lung ; in the perpendicular direction they are longest posteriorly.

The lungs posteriorly present an obtuse margin, anteriorly a thin margin, which is short and irregular. The anterior and inferior margin of each lung is very acute.

The right lung is largest, and generally extends highest in the neck, but is shortest, in consequence of the situation of the liver. It is divided into three lobes, the left into but two.

The *great fissure* which divides each lung into two lobes, runs obliquely from behind downwards and forwards. The superior lobe is the smaller, but forms more of the anterior surface of the lung. The additional lobe on the right side is cut off from the superior lobe, it is small and triangular, and lies behind or sometimes in front of the other lobes.

The lungs have a spongy feel, and crepitate with the pressure of the finger; they are composed of the bronchi, with their ramifications, terminating in air-cells, and lined by a mucous membrane, the pulmonary and bronchial arteries and veins, nerves, absorbents, and glands, connected together by cellular tissue, and invested by their general covering, the pleura.

On examining the minute structure of the lungs, we find them to be composed of a number of lobules, connected together by interlobular cellular tissue. This cellular tissue is extremely delicate, often infiltrated with serum or air, as in emphysema; and gives passage to the minute vessels.

The lobules do not communicate with each other. They are attached to the ramifications of the bronchi and vessels, like grapes to their stalk; and each lobule may be considered as a separate lung. They are not all distended with air in ordinary inspiration, nor by the most powerful efforts that can be made. Those of the upper part of the lungs seem to be most filled, and are most constantly in action.

Each lobule is composed of a collection of air-cells, or vesicles, which communicate freely together; these cells vary in size, and always contain some air in the healthy state. The partition between them is imperfect, and is composed of very delicate cellular tissue. These cells are the terminations of the bronchial tubes, and consist of a thin fibrous tissue, lined with mucous membrane; upon their walls the minute capillary branches of the pulmonary arteries and veins ramify.

The average quantity of the air which the lungs contain is not quite agreed upon: perhaps 200 cubic inches may be taken as the mean. This proportion will vary with the state of inspiration and expiration, as in each of those actions a change of from 30 to 40 cubic inches is supposed to take place. The carbonic acid evolved from the lungs, in twenty-four hours, has been estimated as much as 24,000 cubic inches, sufficient to afford 11 to 12 inches of solid carbon.

The *pulmonary arteries*, unlike other arteries, carry venous blood for the purpose of being converted into arterial. Their coats are thinner than those of other arteries.

The *bronchial* arteries derived from the aorta are designed for the nutrition of the lungs.

The *pulmonary veins* carry arterial or decarbonized blood, and are firmer in their coats than veins in general. They are four in number, terminate in the left auricle of the heart, and do not possess *valves*.

The lungs are supplied with nerves from the pulmonary plexuses, formed chiefly by the par vagum, together with filaments from the sympathetic.

The *absorbents* of the lungs are deep seated and superficial. They pass to the bronchial glands at the roots of the lungs, and then proceed partly to the thoracic duct on the left side, and partly to a corresponding vessel on the right.

The *pericardium*, or investment of the heart, is contained in the middle mediastinum; it is of a triangular shape, the apex above, the base below, and is formed by two membranes: the external one is fibrous; the inner one is serous, lining the fibrous coat, and reflexed over the heart itself. It has also a partial covering from the pleura of each side, and is strengthened below by its attachment to the cordiform tendon of the diaphragm.

The fibrous bag of the pericardium is firmly attached to the central tendon of the diaphragm, inferiorly; laterally, to the pleura; and superiorly it is reflexed upon the large vessels for some distance, and finally becomes continuous with their outer coat. It consists of fibres running in various directions, and is said to have eight openings in it, for the transmission of the large vessels; viz., one for the superior vena cava, two for the right and left branches of the pulmonary artery, one for the aorta, and four for the pulmonary veins. The vena cava inferior is immediately connected with the substance of the heart after its passage through the diaphragm, and it is said not to be surrounded by this fibrous coat.

The lining serous coat is a shut sac, containing a small quantity of thin fluid, for the purpose of lubricating it, and allowing the free motion of the heart in the pericardium: it extends highest on the aorta and pulmonary artery, enclosing these vessels in one sheath; next on the superior cava, which it covers, except on its posterior surface; and least of all on the inferior cava.

The *heart* is a hollow muscle, of rather a pyramidal figure, placed obliquely in the lower and front part of the thorax, and most inclined to the left side. It is convex above, rather flattened below, where it rests upon the diaphragm.

It is commonly described as externally divided into an apex, body, and base, a superior and inferior surface, and a right and left margin. The apex, directed downwards and forwards, points between the cartilages of the fifth and sixth ribs. The base, turned backwards and upwards, corresponds with the fourth and fifth dorsal vertebræ. The right margin is longest but thinnest.

The heart, physiologically, may be considered as double: the right side, called pulmonary, transmits the blood only to the lungs; the other, systemic, forces the blood into all the other parts of the body. The right cavity of the heart is most capacious; the parietes of the left are by far the thickest.

The substance of the heart is formed of its muscular portion, its investing and lining membrane, and its proper vessels and nerves.

The cavities of the heart are four: two at the base, called auricles; and two at the apex, named ventricles.

When the pericardium is opened and the heart is in situ, the right side of the heart principally is brought into view: the parts seen are, the right auricle and ventricle, the termination of the venæ cavæ, the appendix of the left auricle, the part of the left ventricle forming the apex of the heart, the root of the pulmonary artery and aorta, and the proper vessels of the heart, ramifying on its surface.

The *right auricle* of the heart is somewhat quadrilateral in shape; its interior may be divided into the large smooth portion, named *sinus venosus,* and the *auricula propria.*

The openings into the sinus are, one from the superior vena cava, one from the inferior vena cava, one from the coronary vein, and one into the right ventricle; and, according to some anatomists, little venous openings, termed *foramina Thebesii.* The superior cava opens into the upper part of the auricle; its orifice is smaller than that of the inferior cava, and lies on a plane anterior to it. In the septum between the right and the left auricle there is a depression named fossa ovalis, corresponding with the situation of the foramen ovale, in the fœtus, and surrounded, except inferiorly, by the *annulus fossæ ovalis.* There is frequently a slight orifice in the substance filling up the fossa.

A projection may be observed between the openings of the venæ cavæ, named *tuberculum Loweri.* From the upper margin of the inferior cava, a semilunar fold of the lining membrane extends towards the annulus fossæ ovalis, named the *Eustachian valve*, less evident in the adult, but in the fœtus is supposed to direct the blood from the inferior cava into the left auricle; between this and the auriculo-ventricular opening is the orifice of the coronary vein, with a valve partly covering it. The auriculo-ventricular opening is situated in the inferior part of the right auricle.

The *auricula propria* or *appendix auriculæ* communicates with the sinus venosus by a circular opening. It contains fleshy pillars, named *musculi pectinati*, which also extend in a thinner form over the anterior and upper surface of the sinus venosus. Some have supposed that the use of these fibres is to commingle the blood of the two cavæ, which is of a very different quality; that of the upper vessel containing the fluid poured into the circulation by the thoracic duct.

The right ventricle has two openings into it, the *auriculo-ventricular*, and an opening into the pulmonary artery.

It is of a triangular shape, the base being towards the right auricle, the apex near but a little above the real apex of the heart; it is separated from the left ventricle by a thick partition, named septum cordis. The auriculo-ventricular opening is guarded by a fold of the lining membrane, named tricuspid valve, from presenting three triangular portions: of these one is anterior; another posterior; the third, towards the left side, separating this opening from that of the pulmonary artery; this, the largest portion, has been named the septum of Lieutaud: at the attached base of this valve a ring of a tendinous nature is observed underneath the lining membrane; this is named the *zona tendinea*, and enters partly into the structure of the tricuspid valve, giving strength to it. A similar tendinous zone exists at the left auriculo-ventricular opening. These tendinous zones are the most fixed points of attachment for the muscular fibres of the heart. To the edges and under surface of the valve little tendinous strings are attached, named *chordæ tendineæ*, which, at their other extremity, are connected with projecting muscular bundles, named *carneæ columnæ*. At the upper and anterior part, and to the left, is the opening of the pulmonary artery, towards which the walls become smooth. This part is named *pars plana*, and, from an appearance of contracting towards the opening, is called infundibulum.

The carneæ columnæ may be divided into three sets: one attached to the entire length of the wall of the ventricle; another attached by each end, with the centre free, the third attached at one end to the wall of the cavity, the other connected with the chordæ tendineæ.

The carneæ columnæ assist in strengthening the ventricle, aiding in its contraction; the third set draw down the tricuspid valve and prevent it passing back into the auricle during the contraction of the ventricle; they also act on the blood so as to assist in propelling it into the pulmonary artery.

The opening of the pulmonary artery is guarded by three *semilunar* or *sigmoid* folds, or valves, each of which, in the centre of its free margin, has a little granular body, called *corpus sesamoideum*, or *corpusculum Arantii*, which closes up the triangular interval that would otherwise exist between the valves. It is the opinion of some, that the use of these bodies is to prevent the valves being pressed so closely to the sides of the vessel, that the regurgitating blood cannot insinuate itself behind them.

The pulmonary artery, passing upwards and backwards, nearly two inches and a half within the pericardium, divides into right and left branches. The right, which is the largest, passes under the arch of the aorta, and separates into three branches, which ramify in the right lung. The left branch crosses over the descending aorta, and divides into two branches, which, like the right, divide and subdivide, terminating in capillary vessels, which, reflexed, form the commencement of the four pulmonary veins.

In the fœtus there is a third branch, the ductus arteriosus; this stretches from the angle of bifurcation of the pulmonary artery, and extending backwards joins the arch of the aorta at the junction of the transverse and descending portions.

The left auricle, situated at the upper and back part, like the right one, has a smooth portion, named *sinus arteriosus*, and an auricular appendix containing musculi pectinati, but not so large as in the right side. There are five openings into it: four from the pulmonary veins, entering at its angles, and one into the left ventricle, rather smaller than on the right side. The fossa ovalis, with its annulus, may be felt, but is not so evident as in the right auricle.

The left ventricle, of a conical form, has parietes much thicker than the right, and is longer, but its capacity for blood is rather smaller. Its extremity forms the apex of the heart; its inner wall forms the greater portion of the *septum ventriculorum.* It has an opening from the auricle and one into the aorta. The auricular opening is surrounded or guarded by the *mitral valve*, which is strengthened by the *chordæ tendineæ*, and these are attached by their other extremity to the *carneæ columnæ*, which resemble those of the right side, but are stronger and less numerous.

The mitral valve consists of two pieces, of which the right one is much the larger, and is placed between the opening from the auricle and that into the aorta, and is more deserving the name of septum than a similar portion of the tricuspid valve: its use is to divide the two currents of blood. At the upper part of the ventricle, and anterior to the auricular orifice, is the opening into the aorta.

The aorta and pulmonary artery are connected to the heart in a similar manner. The external and internal coats are continuous with those of the heart, but the middle elastic coat has a peculiar arrangement. It is found to commence by a defined edge, presenting three festoons, the convexities of which are implanted into a fibrous ring which intervenes between the artery and the fleshy fibres of the ventricle. At the commencement of the aorta there are three *sigmoid* or *semilunar* valves, with the corpora sesamoidea, as in the pulmonary artery.

The structure of the muscular substance of the heart is very peculiar, and that of the ventricles is most deserving of attention. The ventricles appear to consist of two muscular bags, contained within a third, common to both.

All the muscular fibres take their origin from the tendinous zones, which may be observed between the junction of the auricles and ventricles, and also terminate in them. They are arranged in successive layers, but the fibres of them are in some measure blended with each other, so that it is impossible to assign to them any definite number.

The superficial fibres common to both ventricles are oblique and curvilinear, proceeding from the base towards the apex; those on the anterior surface pass from right to left, those on the posterior inferior surface in an opposite direction. These fibres do not terminate at the apex, but are matted together, and reflexed back towards the base again. Some of the superficial fibres at the apex of the heart are curved and turned inwards, forming reflexed fibres, which constitute the fleshy pillars of the heart.

The proper fibres of each ventricle are placed between the superficial and deep fibres of the common muscular coat, in the form of a cone and resting against each other, with a superior large opening, viz. auricular, and an inferior small one, which gives passage to the deep fibres. They proceed from the tendinous zone, in a spiral manner from the base to the apex and back again. The common reflexed deep fibres pass in, as just mentioned, and diverge in a radiating manner, and are distributed in three modes: some pass to the opposite wall of the interior of the ventricle, others run along the inside of the same wall, and a third set form the carneæ columnæ. The muscular fibres of the auricles are also of two kinds, proper and common: the latter run in a transverse direction; the proper fibres are thin, and take their origin from the auriculo-ventricular zone, and also return to it. Some of these take an oblique, others a perpendicular direction.

The heart is supplied with blood by the coronary arteries; its nerves are derived from the cardiac plexus, which is formed by the sympathetic and a few filaments from the par vagum.

The *aorta* arises from the upper and anterior part of the left ventricle, in front of the left auriculo-venticular opening, and behind the pulmonary artery; from this it first ascends forwards and to the right side, as high as the cartilage of the second rib, it then passes backwards to the left side of the spinal column, whence turning downwards it terminates opposite the left side of the fourth dorsal vertebra in the descending aorta, which finally enters the abdomen through the aortic opening of the diaphragm, and passing down terminates opposite the third or fourth lumbar vertebra, by dividing into the right and left common iliac arteries. The curved portion of the aorta is named its arch, and is divided into the ascending, transverse, and descending portions. The first, or ascending portion, lies within the pericardium; to its left side lies the pulmonary artery, to its right the superior vena cava; the transverse portion extends from the termination of the preceding to the left side of the second dorsal vertebra, whence it terminates in the descending portion, their point of junction being indicated by the attachment of the ductus arteriosus and the hooking round of the left recurrent nerve. The transverse portion of the arch rests on the bifurcation of the trachea; in front of it are the left vena innominata and the thymus gland. The descending portion of the arch lies to the left of the spine. The right pulmonary artery, the left bronchus, the œsophagus, and the left recurrent nerve pass through the arch of the aorta, the thoracic duct passes behind it.

The student should pay particular attention to the relations of the arch of the aorta, as no part of the arterial system is more subject to the disease of aneurism. Tumours of this, as they enlarge in different directions, and so compressing the great veins in the thorax, the œsophagus, and the trachea, may give rise to symptoms resembling those of apoplexy, stricture of the œsophagus, or inflammation of the lungs; or they may press on the spine, and thus similate disease of this structure; or, compressing the heart, may be mistaken for disease of this organ.

The first arteries given off from the aorta are the right and left *coronary*, for the supply of the heart itself. These vessels are sent off from the aorta a little above its origin, and receive their blood in a different manner from all other arteries in the body. The blood enters them by regurgitation, and not from the propelling force of the heart, for when the ventricle contracts and forces the blood into the aorta, the sigmoid valves are pressed laterally against the orifices of the coronary arteries, and thus the blood is prevented entering them.

The *right coronary* artery passes along the right border of the pulmonary artery, then transversely in the groove between the right auricle and right ventricle, to the under surface of the heart, as far as the septum, where it divides into two branches; one runs in the groove between the left auricle and ventricle, anastomosing with the left coronary, the other descends between the two ventricles as far as the apex of the heart.

The *left coronary* artery, smaller than the right, comes off from the aorta, a little higher up, and is first observed between the pulmonary artery and left auricle; when it arrives at the septum ventriculorum, it divides into two branches, one takes a transverse course to the left, running in the groove between the left auricle and ventricle, anastomosing with the right coronary; the other runs down on the upper surface of the heart, along the septum of the ventricles as far as the apex. From these vessels minute branches pass into the several parts of the heart, and supply the roots of the large vessels.

The arteries from the transverse portions of the heart are:

The *arteria innominata,* which divides into right carotid and right subclavian.

The *left carotid.*

The *left subclavian.*

The arteria innominata passes upwards, forwards, and to the right side, and terminates opposite the right sterno-clavicular articulation, by dividing into the right carotid and right subclavian arteries. Behind it is the trachea, and at some distance the spinal column; the right vena innominata lies in front of and to its right side; it is surrounded by branches of the cardiac plexus.

The arteria innominata has been tied, but without success, for the cure of aneurism of the right subclavian in its first stage.

The common carotid divides into external and internal.

The branches from the external carotid are:

Anteriorly,	Superior thyroid.
	Lingual.
	Labial.
Posteriorly,	Muscular.
	Occipital.
	Posterior aural.
Ascending,	Pharyngeal.
Terminating,	Temporal.
	Internal maxillary.
	Transverse facial.

The branches of the internal carotid within the cranium are:

Ophthalmic.
Anterior cerebral.
Middle cerebral.
Posterior communicating.

The branches of the subclavian are:

Vertebral.
Internal mammary.
Inferior thyroid.
Cervicalis ascendens.
Suprascapularis.
Posterior scapular.
Cervicalis profunda.
Intercostalis superior.

The descending thoracic aorta gives off:

Bronchial arteries, to nourish the lungs.
Œsophageal.
Intercostal, to the pleura, intercostal muscles, and spine.

The *bronchial* arteries vary in number from two to five; they come off from beneath the arch, or from the anterior part of the descending thoracic aorta; they accompany the bronchi and their branches, and are considered to be the proper nutritious arteries of the lungs.

The *œsophageal* branches are small and irregular, and are given off from the anterior part of the aorta: they ramify in the œsophagus, and anastomose with the œsophageal branch, given off by the coronaria ventriculi.

The *intercostal* arteries from the aorta take origin rather from its posterior part, and are generally nine on the right and ten on the left side, the others being branches of the superior intercostal, given off from the subclavian. The superior four or five aortic intercostals take origin lower than the parts to which they are distributed; thus they ascend somewhat to arrive at the intercostal spaces; the lower ones pass off almost at a right angle to their destination. These vessels, on arriving at the ribs, run first between the pleura and external intercostal muscles, afterwards between the two layers of intercostals; midway in their course they divide into a superior and inferior branch, corresponding with the edges of the rib above and below, the superior one being larger, and like the continuation of the artery: they both give off branches to the muscles and integuments, and anastomose with the anterior intercostal arteries, branches of the internal mammary. Each intercostal, by the side of the vertebræ, gives off a large posterior branch, which passes backwards between the transverse processes of the vertebræ and divides into ramuli: one to the muscles of the back, some to supply the vertebræ, and one which passes through each invertebral foramen, to supply the spinal chord.

ABDOMEN.

The abdomen, the largest cavity in the body, extends from the diaphragm to the pelvis, which form its superior and inferior boundaries. It is bounded anteriorly and laterally by the abdominal muscles and parietes, and posteriorly by the spine, the quadratus lumborum, and psoæ muscles.

The coverings of the abdomen are, the cuticle, rete mucosum, cutis vera, adipose tissue, cellular tissue (here named fascia superficialis), the muscles with their tendinous expansions, fascia transversalis, and the peritoneum.

Anatomists divide the abdomen, externally, by transverse and longitudinal lines, into three regions; first, a line is drawn round the body, on a level with the cartilage of the ninth rib, and forms the lower boundary of the epigastric region; another line is drawn across on a level with the crista of each ilium, forming a limit between the umbilical and hypogastric regions; a perpendicular line may then be made on each side, from the edge of the eighth rib, to intersect the centre of Poupart's ligament. By this arrangement, the superior zone, or epigastric region, is subdivided into the right and left hypocondrium and proper epigastrium, or scrobiculus cordis; the central zone is separated into the right and left lumbar and proper umbilical region, and the lower portion is partitioned into the right and left iliac, and hypogastric or pubic regions. A line drawn transversely between the centres of Poupart's ligament on each side may subdivide the hypogastric region into the central or pubic region and the two inguinal regions.

The abdomen contains the alimentary canal and its appendages, and part of the urinary and genital organs.

The alimentary canal in the abdomen comprises the *stomach*, the *small* and *large intestines*, which form the membranous viscera.

The appendages are the *liver*, with the *gall-bladder*, the *spleen*, and *pancreas*, forming the glandular viscera.

The urinary organs are the *kidneys*, the *ureters*, and part of the *bladder* when distended.

The genital organs in the abdomen are restricted to the female, and only strictly so in the impregnated state. They are the *uterus*, *Fallopian tubes*, and *ovaries*.

When the abdomen is opened in the usual manner, the parts brought in view are the following: a small portion of the anterior and inferior part of the liver, the fundus of the gall-bladder, a portion of the stomach, and the great omentum, laterally, portions of the colon. If the omentum be raised, the small intestines and transverse colon may be seen, and part of the bladder if it be distended.

In the right hypochondriac region we find the right lobe of the liver, the gall-bladder, a part of the transverse colon and duodenum, and the upper extremity of the right kidney.

In the epigastric region are the left lobe of the liver, the pyloric extremity of the stomach, the pancreas, part of the duodenum, the semilunar ganglion and solar plexus, the cœliac axis, aorta, vena cava, and crura of the diaphragm.

In the left hypochondriac region are the cardiac end of the stomach and spleen.

The right lumbar region contains the ascending colon and right kidney; the left contains the descending colon and left kidney.

The umbilical region contains small intestines, mesentery, part of the aorta, and vena cava. The transverse colon and mesocolon separate the epigastric and umbilical regions.

In the right iliac fossa the cœcum and vermiform appendices are lodged, in the left the sigmoid flexure of the colon.

The hypogastric region contains the pelvic viscera, consisting of the bladder, small intestines, and rectum, in the male; and in addition, in the female, the uterus and its appendages.

The *peritoneum* is an elastic serous membrane, lining the cavity of the abdomen, and investing the various viscera, giving them strength and support. Its reflexions from one viscus to another form duplicatures, which receive different names, according to their situation. The reflexion of the peritoneum, from the diaphragm to the liver, forms the ligaments of the liver; that from the liver to the stomach forms the lesser omentum; that from the stomach to the transverse colon forms the great omentum; the portion inclosing the colon forms the mesocolon; that which extends down and over the small intestines is called the mesentery. There are, besides these, the ligaments of the bladder, uterus, and rectum, and also the appendices epiploicæ, which are formed by it. In the male the peritoneum is a perfectly shut sac; but in the female there is an opening into it on each side, from the Fallopian tube, the only instance in the body in which a mucous and serous membrane communicate. It must be borne in mind that all the viscera are external to the peritoneum.

Reflexions of the Peritoneum. Tracing the peritoneum upwards from the abdominal muscles, it lines the under surface of the diaphragm, passes on to the liver (forming its ligaments), and at its concave part meets a layer coming from the pillars of the diaphragm and under surface of the stomach. The two layers pass forwards to the small curvature of the stomach, forming the lesser omentum, cover the stomach, meet at the great curvature, whence they descend into the hypogastric region, become reflexed on themselves, and ascend to the transverse colon, thus forming the great omentum; they then embrace the colon, meet again, forming the mesocolon, and again separate into two layers. The lower layer passes down, is reflexed from the spine to the small intestines, surrounds them, and returns to the spine, forming the mesentery, then descends laterally over the kidneys, part of the rectum, mounts up towards the bladder and uterus, and ascends upon the abdominal parietes. The upper layer of the mesocolon goes over the pancreas, duodenum, and crura of the diaphragm, and rises to meet the other portion at the under surface of the liver.

This portion of the peritoneum lines a space, called the bag of the omentum, which has not a very free communication with the rest of the abdominal cavity. The only opening into it is behind the rounded edge of the lesser omentum, which contains the large hepatic vessels, and is by some called Glisson's capsule. The passage is named the *foramen of Winslow;* and its boundaries are as follows:

Anteriorly,	the lesser omentum, containing the hepatic artery, vena portæ, and ductus communis choledochus.
Posteriorly,	the ascending layer of the transverse mesocolon.
Superiorly,	lobulus caudatus of the liver.
Inferiorly,	the superior portion of the duodenum.

The *stomach* is a musculo-membranous bag, interposed between the œsophagus and duodenum. It is situated in the left hypochondrium, under the left false ribs, extends across the epigastric region, and slightly into the right hypochondrium.

The parts in relation with it are,

Above and in front,	the liver, diaphragm, and ribs.
Inferiorly,	the colon and mesocolon.
Posteriorly,	the pancreas, spleen, and left supra-renal capsule.
At its right extremity,	the duodenum, liver, and gall-bladder.

There are two openings into it, the *cardiac* or *œsophageal* and *pyloric.* The former is most posterior and superior, so that the stomach inclines obliquely forwards and downwards.

There are two surfaces, an anterior and posterior, in the ordinary state; but when the stomach is distended, the anterior becomes superior, and the posterior, inferior; the lesser arch is carried further backwards, and the greater more forwards, extending even into the umbilical region. In this state of the stomach, its right extremity is in close contact with the gall-bladder.

The stomach in its figure resembles a curved or oblong cone; it is largest at its œsophageal end: the left third beyond the œsophagus is called the cul-de-sac of the stomach, which in the child scarcely exists, and which affords an explanation why they vomit with so much facility.

The pyloric orifice is even smaller than the commencement of the duodenum. It is so situate, as in a great measure to form an acute angle with the duodenum.

The stomach is kept in its situation by its union with the œsophagus and duodenum, by the lesser and greater omentum, by the splenic omentum, and by the peritoneum attaching it to the diaphragm.

The stomach is formed by four coats, a *peritoneal*, *muscular*, *nervous*, and *villous*, connected together by cellular tissue.

The *peritoneal coat* is external; it is a continuation of the small and great omentum, smooth and shining, and attached by its inner rough surface to the muscular coat. It does not cover the stomach along either curvature.

The *muscular coat* consists of three series of fibres, longitudinal, circular, and oblique.

The *longitudinal* or *external fibres* are continued from the œsophagus; they spread out upon the surface of the stomach, and, on reaching the pylorus, are collected into bundles, somewhat as in the large intestines. The external fibres are softer and more diffused than the internal ones, and are more evident along the curvatures.

The *oblique* or *transverse fibres* form the deepest layer; they surround the stomach obliquely, often crossing each other, and are most abundant about the cul-de-sac.

The *circular fibres*, continued from the œsophagus, are most evident at the right end of the stomach: in the centre they are often strong, and give an hour-glass appearance to the stomach. At the pylorus, they are much developed, and form, as it were, a sphincter to it.

The *nervous* or *fibrous coat*, rarely described by anatomists at present, is situated between the muscular and mucous coats; it is distinguished by its white colour and its loose texture, and affords a medium for the distribution of the vessels which are to supply the other coats. It is continuous with a corresponding membrane in the œsophagus.

The *lining* or *mucous coat* is corrugated, soft, and of a reddish colour. It is always moist, and lubricated by a tolerably thick mucus. The *rugæ* run in different directions: those near the œsophagus have a stellated appearance; others, and the most constant, run longitudinally from the great end to the pylorus, connected by lateral prominences. These almost disappear when the stomach is much distended. A distinct loose fold of it assists in the formation of the pylorus.

This membrane, minutely inspected, presents an immense number of small prominences, which give the villous appearance. They appear to be composed of a delicate network of vessels, with perhaps orifices of absorbent vessels.

The stomach is studded with mucous follicles, situated between the rugæ, and these have been named *glandulæ Brunneri*, most numerous at the œsophageal end, and along the curvatures.

The arterial branches for the supply of the stomach are all from the cœliac axis. They are the *coronaria ventriculi* or *superior gastric*, distributed to the smaller curvature; the *superior* and *inferior pyloric*, to its pyloric end; and the *vasa brevia*, *gastrico-epiploica sinistra* and *dextra*, to the larger curvature.

Its nerves are chiefly from the par vagum, with some filaments from the sympathetic and phrenic.

Its veins pass chiefly into the splenic vein, and its absorbents into the thoracic duct.

The intestines are divided into small and large. The length of the human intestinal canal is about six times greater than that of the trunk; and is still longer in proportion in graminivorous animals.

The small intestines are the *duodenum*, *jejunum*, and *ilium*. In length they form about two thirds of the intestinal canal.

The small intestines, as also the large, have the same coats as the stomach, but with some exceptions, in relation to the peritoneum. These coats are generally stated to be three. The muscular coat consists of two series of fibres, longitudinal outside, circular inside. The mucous or villous coat, which is much the largest in the small intestines, is arranged in folds, named valvulæ conniventes, to afford a larger surface for absorption, and to cause some retardation in the passage of the chyle. This coat is studded with mucous follicles; those of the duodenum are named glandulæ Brunneri; those in the jejunum and ilium, glandulæ aggregatæ or Peyeri.

The first portion, the *duodenum*, so named from its length being equal to the breadth of twelve fingers, *i. e.* from eight to nine inches, commences at the pyloric end of the stomach.

It is rather larger than the other small intestines, and, from a supposed marvellous distensibility, has been named *ventriculus succenturiatus*.

It is also imagined that it is less covered by peritoneum, in order that this distension may be more easily accomplished.

The duodenum first inclines upwards, backwards, and to the right, and having arrived near the neck of the gall-bladder, it bends vertically downwards, and again changes to a transverse direction, thus forming two curves or angles, embracing the head of the pancreas. Hence it is convex to the right, concave internally and to the left; and is divided into three portions.

The *first* portion of the duodenum is in immediate relation with the liver and neck of the gall-bladder, posteriorly with the hepatic vessels and small omentum, and is almost entirely surrounded by peritoneum. Its length is about two inches.

The *second* portion, perpendicular, has

In front and externally,	the ascending colon.
Behind,	the concave portion of the right kidney.
Internally,	the pancreas.

This part is from two to three inches long; at about the middle of its posterior surface is the opening from the ductus choledochus and pancreatic duct; it is only covered anteriorly by peritoneum.

The *third* portion, transverse, is covered, anteriorly, by the mesocolon.

Bounded above,	by the pancreas.
Anteriorly,	by the stomach.
And posteriorly,	by the vena cava, aorta, and crura of the diaphragm.

It is crossed at its termination in the jejunum, by the superior mesenteric artery.

The regions occupied by the duodenum are the right hypochondrium, the right lumbar slightly, and finally, the junction of the proper epigastric and umbilical regions.

It is distinguished from the jejunum and ilium by being shorter, more partially covered by peritoneum, confined to its position, and by having more openings into it. Its muscular fibres are chiefly circular.

The *ductus communis choledochus*, after passing some way between the muscular and mucous coats, opens into the duodenum, near the junction of the second and third portions, and generally by a common orifice with the pancreatic duct. It occasionally enters as high up as the superior curve or angle, at a distance of two or three inches from the pylorus. The arteries of the duodenum are from the hepatic and superior mesenteric. In this intestine, chylification takes place.

The rest of the small intestines consist of the jejunum and ilium.

The upper two fifths of this portion of the intestines is called *jejunum*, and the lower three fifths *ilium*.

The *jejunum*, so named from being generally found empty, terminates in the ilium, and closely resembles it in its structure.

The distinctive characters of the *jejunum* from the ilium are, its coats are thicker, it is of a redder colour, has more valvulæ conniventes, and consequently a greater surface for absorption.

The jejunum and ilium occupy, in part, the umbilical region, parts of the lumbar, iliac, and hypogastric regions, and in some measure rest in the pelvis of the adult. They are covered anteriorly by the great omentum, and surrounded by the arch of the colon.

In the lower part of the ilium there is a large number of mucous glands or follicles, named Peyer's glands, collected into clusters, hence named glandulæ aggregatæ; they occupy the surface of the intestine, most distant from the mesentery. In typhus fever and phthisis they are often found inflamed and ulcerated.

The jejunum and ilium are supplied with blood by the superior mesenteric artery.

The large intestines commence at the termination of the ilium in the right iliac fossa; they are the *cæcum*, *colon*, and *rectum*. They have the same coats as the small intestines. Their length is from three feet and a half to four feet, forming about a fifth of the intestinal tube.

The large intestines are particularly characterized by their sacculated appearance, occasioned by ligamentous bands, and differ from the small intestines in being wider, shorter, straighter, and more fixed, and by having the appendices epiploicæ attached to them.

The *cæcum*, or *caput coli*, is the first portion; it commences from the ilium, and is situated beneath the right kidney, resting on the right iliac fossa.

It is bounded in front by the abdominal parietes; behind by the iliacus muscle; internally, has the ilium opening into it. It is generally covered by peritoneum on its anterior surface only, but sometimes is surrounded by it, like the colon; and may then be said to be attached by a meso-cæcum.

At the junction of the cæcum and colon with the ilium, the lining membrane, with muscular fibres, forms folds, called *ilio-cæcal* and *ilio-colic valves.*

These valves present each a concave border, looking upwards and towards the right. The ilio-colic portion is more horizontal; the ilio-cæcal nearly perpendicular: they are united at each extremity, and if either of them be pressed against, the opening between them becomes almost perfectly closed.

There is a little worm-like appendage attached to the cæcum at its under and back part, called *appendix vermiformis.*

This varies in length from one to six inches, and is ordinarily of the size of a goose-quill. Its precise position is very uncertain, although it more frequently projects or hangs down over the border of the pelvis. Its cavity communicates with that of the cæcum, is small, ending in a cul-de-sac, and contains a little mucus. Its structure is like that of the large intestines. The use of this body is unknown.

The colon is divided into four portions; the *ascending*, the *transverse*, the *descending*, and its *sigmoid flexure*, which terminates in the rectum, opposite the left sacro-iliac synchondrosis.

Little folds of peritoneum, containing fat, hang down from the colon, called *appendices epiploicæ*.

The ascending colon passes up on the right side, bounded

In front,	by the abdominal parietes.
Behind,	by the quadratus lumborum and right kidney.
Above,	by the margin of the liver.

The transverse colon extends from the right to the left hypochondrium, along the junction of the epigastric, with the umbilical region; on the right side it touches the gall-bladder, on the left it is just below the spleen: it is kept in its place by the transverse mesocolon: thus, above it, we find the liver, which is sometimes slightly grooved for it, the gall-bladder, the stomach, and lower part of the spleen. Below the transverse colon there are only the small intestines.

The left lumbar, or descending colon, is bounded in a very similar manner to the right, as to the parietes and small intestines, only reversing the sides; its caliber is rather less, and at the upper part it is deeper seated.

The *sigmoid* flexure of the colon is situated in the left iliac fossa. It is connected by a rather loose fold of peritoneum, which allows it a considerable degree of motion, and, from its curved form, is supposed to be intended for a partial reservoir of fæcal matter. It is bounded in front by the abdominal parietes; behind, by the iliacus muscle, on which it rests; internally, it is in relation with the small intestines.

The longitudinal bands, which are three on the ascending and transverse colon, often merge into two in the descending and sigmoid portions, and the sacculi are frequently less developed.

The *rectum* commences at the sigmoid flexure of the colon, and terminates in the anus.

Arising from the left side, it immediately inclines to the mesial line, follows the curve of the sacrum, and terminates at about an inch beyond and before the coccyx: from this bone it turns a little backwards, and is thus removed from the vagina of the female, and urethra of the male.

It is cylindrical in shape, and not sacculated like the colon, in consequence of being devoid of the longitudinal bands; the longitudinal fibres are dispersed over it generally; it is narrowest at its upper part, and becomes gradually dilated till it arrives near the anus, just above which the dilatation is considerable, like a large reservoir, which sometimes is enormously distended with fæces.

Boundaries and *relations*. Behind it, first, there is the sacro-iliac symphysis, then the curvature of the sacrum and coccyx; superiorly, it is attached to the sacrum by a fold of peritoneum, named mesorectum, and is separated from the symphysis and sacrum by the pyriformis muscle, the sacral plexus, and hypogastric vessels. In the portion beyond the coccyx, the levator and sphincter ani form a kind of floor for it.

The inferior third of the rectum is wholly destitute of peritoneal covering; hence we are enabled to operate on this part of the intestine, as for fistula in ano and hemorrhoids, without injury to the peritoneum.

In front, the rectum is free at its upper part, but adherent in the lower portion; and, as its relations vary with the sex, they must be spoken of separately.

In the male the upper part looks towards the posterior wall of the bladder, from which it is separated by some convolutions of the small intestines; at its adherent portion, lower down, it is in relation with the bas-fond, or lower fundus of the bladder, where the trigone is situated, and which thus rests upon the rectum. The peritoneum sometimes descends so as to cover this part, and may even extend as far as the prostate gland, forming a cul-de-sac lower than usual; further down, the rectum is in close contact with the prostate gland; and still further, has some relation to the urethra, but is separated from it by a triangular space, the base of which is forwards and downwards, the apex upwards and backwards.

In the female, the free portion of the rectum is in apposition with the broad ligament, Fallopian tube, and ovary of the left side, the uterus, and the vagina. Between these parts and the rectum there is a cul-de-sac of peritoneum, as in the male between the rectum and bladder; in this part, when the rectum and uterus are comparatively empty, there are some convolutions of the small intestines. In the lower part, the rectum is in immediate connexion with the vagina, to which it is very adherent; but as it descends still lower it quits the vagina as it turns backwards, and leaves a perineal triangular space, analogous to that in the male. On its sides the free part of the rectum has convolutions of the small intestines, but lower down a large quantity of loose cellular tissue containing a considerable quantity of fat.

The inside of the rectum presents a number of longitudinal folds, like those of the œsophagus; and these are intersected by a few semicircular ones. The longitudinal folds have been named the pillars of the rectum.

The cæcum and one half of the colon are supplied with blood from the superior mesenteric artery; the rest of the colon and upper part of the rectum, from the inferior mesenteric; the rest of the rectum receives blood from the middle hemorrhoidal and internal pudic artery. The rectum is one of the most vascular parts of the intestinal canal.

The veins of the intestines terminate in the *vena portæ*.

The nerves are derived from filaments of the lumbar ganglia of the sympathetic and solar plexus; the latter sends off minor plexuses to accompany each artery, whence they are named.

The rectum alone is supplied with nerves, both from the ganglionic and cerebro-spinal system. This is necessitated by the functions of this intestine, which is partly under the influence of the will, and partly independent of it.

The *liver* is a conglomerate gland, the largest of the body, from three to four pounds in weight; it is situated in the right hypochondrium, epigastrium, and part of the left hypochondrium. It is superiorly convex, and inferiorly concave. It is divided, for the sake of description, into a right and left lobe; on the under surface of the right or large lobe, some anatomists describe three divisions or lobes, with the names *lobulus Spigelii*, *lobulus* *caudatus*, and *lobulus quadratus*. The latter is the quadrangular portion, bounded by the gall-bladder to the right, the transverse fissure behind, fossa umbilicalis to the left, and acute margin of the liver in front and below. The lobulus Spigelii is behind the transverse fissure, between the vena cava inferior, and fossa ductus venosi. The lobulus caudatus is a tail-like process which extends from the lobulus Spigelii, across the vena cava to the right extremity of the liver.

The *liver* is kept in its place by five ligaments, which are named the *broad*, the *round*, the *right* and *left lateral*, and the *coronary* ligament.

These ligaments are formed by the peritoneum, excepting the round ligament, which consists of the remains of the umbilical vein. The broad or falciform ligament connects the anterior surface of the liver to the abdominal parietes. The lateral ligaments attach the right and left lobes of the liver to the diaphragm: the left is the largest and lies directly in front of the cardiac orifice of the stomach.

The coronary ligament is formed by the splitting of the two layers of the falciform ligament, near the obtuse margin of the liver; it bounds a triangular space in which the openings of the venæ cavæ hepaticæ are situated.

The round ligament stretches from the umbilicus, upwards, backwards, and to the right side, contained in the free edge of the falciform ligament, as far as the longitudinal fissure.

The liver has two coats, the peritoneal and the tunica propria, of cellulo-fibrous structure, which also surrounds the different vessels, and accompanies them to their minutest ramifications, thus forming the real capsule of

Glisson. The tunica propria, or fibrous coat, is best marked where the peritoneal covering is deficient, namely, at the coronary ligament, beneath the gall-bladder and the vena cava. There are five fissures or depressions of the liver, viz. the *great* or *longitudinal fissure*, which extends from the thin to the thick margin, between the right and left lobes, and may be divided into two parts; the anterior half, named *fossa umbilicalis*, giving lodgement to part of the round ligament in the adult, and to the umbilical vein in the fœtus; the posterior half, named *fossa ductus venosi*, from its function during fœtal life; the *fissure* for the *vena portæ*, named sulcus transversus, or sinus venæ portarum, passes transversely to the right side, from nearly the centre of the preceding, and occupies the middle third of the liver; through it pass the great vessels, nerves, biliary ducts, and absorbents; that for the *vena cava*, which lies to the right of the Spigelian lobe, and is as frequently a canal; and the depression for the *gall-bladder*.

There are also several depressions of the liver mentioned, but they are generally very indistinct: there is one for the stomach, one for the colon, and one for the right kidney, and a groove for the œsophagus.

The liver may be considered as a collection of little livers or acini, which are composed of *ramifications of blood-vessels*, *absorbents*, *biliary ducts*, and *nerves*, connected together by cellular substance.

The minute structure of the liver has been investigated by Mr. Kiernan, one of the most skilful anatomists of the present age. The results of his observations have the following purport:

He first commences by stating that the liver has three surfaces, viz. the commonly received surface, the portal surface, and the hepatico-venous; the two latter are such as would be exposed by mechanically separating the lobules of the liver from the branches of these vessels.

The ramifications of the venæ hepaticæ resemble a tree with its branches, upon which the lobules are placed.

The lobules have somewhat an hexangular form, connected together by a delicate cellular tissue, but presenting between each other interlobular spaces, which lodge the interlobular veins.

The interlobular veins are the minute ramifications of the vena portæ, after it has received the small branches of the hepatic artery. These interlobular veins send into each lobule, from its circumference to its centre, minute branches, which conjointly form the lobular venous plexuses: these minute branches terminate in biliary pores, and in reflexed minute vessels in the centre of the lobule, which are named intralobular veins. These intralobular veins pass into the sublobular veins, which are the primary rootlets of the venæ cavæ hepaticæ. The hepatic artery, after entering the portal canals, divides into branches, which are supposed to nourish the liver, and subsequently are lost to view by passing into the branches of the vena porta, and thus forming a single ramifying vessel.

The biliary tubes, commencing in each lobule, emerge at the circumference, run in the interlobular spaces, and, by uniting together in the portal canals, form, ultimately, the hepatic duct.

The tunica propria is reflexed internally at the transverse fissure, giving a covering or sheath to the vena portæ, the hepatic artery, and biliary tubes; and thus forms the portal canals, which are distributed upon these vessels to their most minute ramifications.

The blood-vessels of the liver are, the *hepatic artery*, for its nourishment; the *vena portæ*, which ramifies through it to secrete the bile; and the *venæ hepaticæ*, which return the blood from the hepatic artery and vena portæ to the vena cava. The *nerves* are from the solar plexus, par vagum, and a few filaments from the phrenic.

The vena portæ is formed, towards the left side of the first lumbar vertebra, by the junction of the *superior* and *inferior mesenteric veins* with the *splenic vein*, and branches from the stomach, pancreas, and gall-bladder. It carries blood of a very dark colour, and is unlike all other vessels of the body; for it commences, like a vein, by small branches which converge to form a large trunk behind the pancreas, and, entering the liver, resembles an artery in its mode of division, ramifications, and functions; it does not possess valves.

The excretory ducts of the *liver, tubuli, biliarii*, arise from the acini, and ultimately join to form the right and left hepatic ducts; these unite and form the *hepatic duct*, which unites with the *cystic duct*, and forms the *ductus communis choledochus*.

The *gall-bladder* is attached to the concave surface of the right lobe. It consists of a *fundus*, *body*, and *cervix*. It has three coats, a partial, external, or peritoneal, a middle one, fibrous, and a villous coat. A duct proceeds from the cervix, called *ductus cysticus*, which joins the hepatic duct, and forms the *ductus communis choledochus*. This duct is about two inches and a half in length, and terminates in the duodenum.

The lining coat of the gall-bladder has a reticulated honeycomb appearance, but does not possess any follicles for the purpose of secretion. It is useful as a reservoir of the bile, and may possibly absorb some of the thinner parts of this fluid.

The cystic duct presents internally a number of folds, which are generally circular; sometimes they run perpendicularly, or in a spiral direction. Their free edge is concave. They are not sufficient to arrest the progress of fluid either way. The cystic duct is a fibro-mucous structure.

The vessels and nerves of the gall-bladder are derived from those of the liver.

The *pancreas* is a long, flattened, glandular body, placed in the back part of the epigastric region, behind the stomach and ascending layer of the mesocolon, and in front of the spine. Its greater extremity, named the *head*, is connected by cellular substance with the duodenum; its lesser, called the tail, with the spleen. It has the stomach and small omentum in front, and is opposite the first lumbar vertebra. The parts found posterior to it are the splenic and superior mesenteric veins, the trunk of the vena portæ, the superior mesenteric artery and accompanying nerves, the vena cava, the aorta, and pillars of the diaphragm: towards the left side it is in immediate relation with the renal vessels, the left kidney, and its capsule. Its upper margin is grooved by the splenic artery, and is contiguous to the first portion of the duodenum, the lobulus spigelii, and cœliac axis; its lower border, thinner, rests against the duodenum and superior mesenteric artery; its head rests against the concavity of the duodenum, and touches the ductus communis choledochus; the left extremity rests against the spleen.

It resembles the salivary glands in structure, and is nearly identical in the fluid it secretes; hence it is often enumerated amongst the salivary glands. It has no distinct capsule, but a delicate cellular tissue unites the various lobules together. Each lobule emits a duct which passes directly into the large duct, running the whole length of the pancreas near the posterior surface, and from left to right. The pancreatic duct pours its fluid into the ductus choledochus, just before it opens into the duodenum; sometimes there is a second duct, which perforates the duodenum separately.

The arteries of the pancreas are branches from the hepatic, splenic, and superior mesenteric. Its veins go to the vena portæ, and its nerves are from the great solar plexus.

The *spleen* is a soft oblong body of a purplish colour, situated in the left hypochondrium, between the large extremity of the stomach and the false ribs; its lower part is behind the colon, and rests upon the upper end of the left kidney; it is externally convex, internally concave, and is covered by peritoneum and its tunica propria.

The internal structure of the spleen is much disputed; some contend that the splenic artery terminates in very small branches, which are coiled up like the shell of a snail, and which admit of considerable distension: these have been named *helicine* arteries. This organ seems to be largely composed of cells, which communicate freely with the veins, as may be seen by injections, but less freely with the arteries; they seem to be an interposed structure, between the two vessels; they are elastic, and at times are liable to enormous distension, as in agues. A quantity of dark fluid is obtained from the spleen by pressure; this may be washed away by water, but does not seem to be of the nature of a secretion, for it has no excretory duct. It varies in size at different periods of life; it is smallest in the infant, and becomes gradually larger as age advances.

Its artery, called the *splenic*, arises from the *cœliac*. Its veins assist in forming the vena portæ; it receives nerves from the solar plexus.

The *kidneys* are two oval glandular bodies, smooth on their surface, but lobulated in the fœtus during the early months, placed behind the peritoneum on each side of the spine, resting upon the diaphragm and quadrati lumborum muscles, opposite the two last dorsal and two superior lumbar vertebræ. The right is a little the lower, in consequence of the situation of the liver. They are about four inches in length and two in breadth; they have two surfaces, an anterior one convex, a posterior one flattened; they have two extremities, of which the superior is the largest and nearest the spine; a convexity externally, and a concavity internally.

The boundaries of the right kidney are, superiorly, the renal capsule and liver; inferiorly, the cæcum, but scarcely ever descends so low; anteriorly, the ascending colon and duodenum; posteriorly, the diaphragm and quadratus lumborum; externally, the diaphragm and abdominal parietes; internally, the crura of the diaphragm, the psoas muscle, large vessels of the kidney, with the vena cava and spine.

The boundaries of the left kidney are, superiorly, the spleen; externally and posteriorly, as on the opposite side; anteriorly, the descending colon; and internally, its vessels, the crura of the diaphragm, psoas, aorta, and spine.

The kidneys have a *proper coat*, of a fibrous or cellular nature, and an anterior covering only of peritoneum;

they are generally imbedded in a quantity of fat and loose cellular tissue.

They are composed of two substances: the outer portion, called *cortical* or *granular;* the inner one, *tubular* or *medullary.*

The cortical part, of a red colour, is about two lines thick, and sends prolongations inwards, between the medullary cones, where it is of much greater depth. It consists of an immense number of small granules, which give origin to the urinary tubes; also of the minute ramifications of the renal artery, which terminates in them, and secrete the urine. In this part the urinary tubes are tortuous, and are continued into the tubular portion. These several parts are so delicate that they require microscopical examination, without which, some anatomists state that the cortical part consists solely of the minute ramifications of the renal artery.

The medullary or tubular part consists of the *tubuli uriniferi,* which are arranged in straight lines and in conical bundles, the base of which faces, externally, the apex towards the pelvis of the kidney. These cones are about ten or twelve in number; their apex is called the *mamilla* or *papilla,* which is surrounded by a membranous tube, called *calyx.* These *calices,* by uniting, form three or four large tubes, named *infundibula,* which open or dilate into the large fissure of the kidney, called *pelvis.* The pelvis of the kidney, in respect to the artery and vein, is behind and below. The emulgent vein is anterior, and the renal artery between them. The calices are less numerous than the papillæ, these fewer than the cones.

The kidneys are supplied with blood by the renal arteries, which arise from the lateral surface of the aorta, descend outwards, and divide into five or six branches before entering into their substance. These branches pass between the medullary cones, and terminate in capillary ramifications around the commencement of the urinary tubes.

The right renal artery is the longest, having to pass behind the vena cava to its distribution.

The renal veins, also called emulgent, empty their contents into the inferior vena cava; the left one is longest, having to cross over the aorta. It generally receives the left spermatic vein.

The nerves are from the renal plexus of the sympathetic, which is formed by the lesser splanchnic nerve, with filaments from the lumbar ganglia.

The *lymphatics* are numerous, and pass into the thoracic duct.

The renal *capsules* are flattened bodies, resting on the upper extremity of each kidney. They are convex above and concave below; yellowish on the outside, browner inside, and generally have a cavity containing fluid. They are larger in the fœtus, and until the third month of fœtal life exceed the kidney in size, but are diminished at birth, and gradually decrease in size with age.

They have sometimes an artery direct from the aorta; their veins terminate in the vena cava on the right, and in the emulgent vein of the left side. The use of them is not known.

The *ureters*, continuous tubes from the pelvis of the kidney, are about eighteen inches in length. They descend behind the peritoneum, over the psoæ muscles and large iliac vessels, enter the pelvis, and perforate the coats of the bladder, along which they run for about an inch, and terminate in the bladder, about an inch from its cervix, forming the posterior angles of the trigonum vesicæ.

They are of about the size of a goose-quill, have two coats, the outer one fibrous, and the thin lining mucous coat: the narrowest part is between the coats of the bladder. Their oblique passage, between the coats of the bladder, serves the purpose of a valve, to prevent the urine from passing back from the bladder.

In the male they are crossed at their upper part by the spermatic vessels; lower down they cross the umbilical artery, or the cord which is left by it, the obturator vessels, and vas deferens. The latter hooks round the ureter, and then descends internal to it, to reach the vesicula seminalis of its corresponding side.

In the female they are crossed by the spermatic vessels, the Fallopian tubes, and broad ligaments; they run along the sides of the vagina, and when in the coats of the bladder are in close relation with the neck of the uterus.

THE ABDOMINAL AORTA AND ITS BRANCHES.

The *Abdominal Aorta* extends from between the crura of the diaphragm at a point opposite the lowest dorsal vertebra to the lower part of the fourth lumbar vertebra, where it bifurcates into the common iliacs.

The branches given off from it are:

Two phrenic.
Cœliac axis.
Superior mesenteric.
Two capsular.
Two renal.
Two spermatic.
Inferior mesenteric.
Four or five lumbar on each side.
Sacra media.

The *phrenic* or diaphragmatic arteries are small, and pass on each side upwards, forwards, and outwards, giving off branches which anastomose with the internal mammary and epigastric, and the lower intercostal. They give branches to the crura of the diaphragm and renal capsules; the left gives off ramuli, which anastomose with the œsophageal vessels.

The *cœliac axis* arises close below the phrenic, is a short trunk, surrounded by the solar plexus of nerves; it inclines a little downwards, and divides into three branches, viz.

Coronaria ventriculi.
Hepatica.
Splenica.

The *coronaria ventriculi*, or *gastrica superior*, the smallest branch both in the fœtus and adult, inclines forwards, upwards, and to the left towards the cardiac orifice of the stomach, where it gives off an œsophageal branch, which runs through the œsophageal opening of the diaphragm, and ramifies upon the œsophagus, anastomosing with the œsophageal arteries; it then takes a course along the small curvature of the stomach, supplying branches to its anterior and posterior surfaces, and to the small omentum, and at the pylorus anastomoses with the pyloric arteries.

The *splenic* artery, rather tortuous, and largest of the three branches in the adult, runs horizontally towards the spleen, resting upon the upper edge of the pancreas, in which it is occasionally somewhat embedded; in its course it gives off some small branches to the pancreas, named *pancreaticæ parvæ*, and one larger, which entering the pancreas runs from left to right with the pancreatic duct, and is named *pancreatica magna;* near the spleen it gives off a large branch to the stomach (*gastro-epiploica sinistra*), which runs along the great curvature, and anastomoses with a similar vessel from the right; it then divides into five or six branches, which generally give off some ramuli to the great end of the stomach (*vasa brevia*), and then enter the spleen, to ramify in it.

The *hepatic artery*, largest in the fœtus, is next in size to the splenic in the adult. It inclines a little forwards, upwards, and to the right, to reach the transverse fissure of the liver, and in its course gives off the following branches.

1st. The *pylorica superior*, a small irregular branch, which passes up behind the pylorus, and anastomoses with the coronaria ventriculi.

2d. The *gastro-duodenalis*, a very large branch, almost equal in size to the continued hepatic trunk: this first gives off a small branch (*pylorica inferior*), which is distributed as its name implies, but is irregular in its origin. The vessel then appears to divide into two trunks, viz. *pancreatico-duodenalis* and *gastro-epiploica dextra*. The pancreatico-duodenalis runs in the groove between the head of the pancreas and the inner margin of the duodenum, in its course supplying branches to both, and terminates by anastomosing with a branch of the superior mesenteric artery. The gastro-epiploica dextra runs along the great curvature of the stomach from right to left, supplying that viscus and the great omentum with branches, and anastomoses freely with the gastro-epiploica sinistra and the coronaria ventriculi.

The hepatic artery, on reaching the transverse fissure of the liver, divides into two trunks, viz. dextra and sinistra, which divide and subdivide in the structure of the liver, The right branch gives off the *cystic* artery, which divides into two branches on reaching the gall-bladder; one of them runs superficially, the other deeply between the gall-bladder and the liver.

The *superior mesenteric* artery arises from the aorta, about half an inch below the cœliac axis; it passes downwards and forwards between the pancreas and duodenum, and then arrives at the mesentery, between the folds of which it descends obliquely towards the right iliac fossa, thus forming an arch, the convexity of which looks downwards to the left, the concavity upwards to the right. From the convexity from fifteen to twenty branches are given off, named *rami mesenterici;* in the mesentery these anastomose together and divide into branches, which branches also anastomose together, and subdivide again, thus forming a series of arches three or four in number, and arrive at the small intestines in a minute state of division. From the concavity there is first given off, just below the pancreas, a small branch, which anastomoses with the pancreatico-duodenalis; next the *colica media*, which passes forwards to the transverse colon, supplying it with branches; then the *colica dextra*, which passes transversely to the ascending colon, and lowest down the *ileo-colica*, which gives branches to the first portion of the colon, the cœcum, and vermiform appendage, and anastomoses freely with the lower rami mesenterici.

All the colic branches anastomose freely together.

The *capsular* arteries arise next, are small in size, and uncertain in their origin; they pass obliquely to the renal capsules, which they supply, and anastomose with the diaphragmatic arteries.

The *renal* arteries come off next from the sides of the aorta, almost at a right angle, a little below the superior mesenteric; they are of a large size, pass directly to the kidneys, but, before entering them, divide into five or six branches, part of which pass in front of, part posterior to, the pelvis of the kidney.

The *spermatic* arteries proceed rather from the front of the aorta; they are small, long, and somewhat tortuous vessels, most so in the female; they pass down on the psoæ muscles, in front of the ureter, and cross the external iliac artery, and at the internal abdominal ring enter into the composition of the spermatic cord, along which they proceed to supply the different parts of the testicle. The distance of their origin from their destination in the adult is owing to the primary situation of the testicle, which was just below the kidney, and immediately opposite to that portion of the aorta from which these arteries were given off. In the female, the spermatic arteries descend, pass between the layers of the broad ligament of the uterus, and are distributed to the ovaries, fallopian tubes, and round ligaments, and anastomose with the uterine arteries.

The *inferior mesenteric* artery arises from the front of the aorta, but a little inclined to the left side, and descends towards the sigmoid flexure of the colon. It divides into three principal branches, viz. the *colica sinistra*, *sigmoidea*, and *hæmorrhoidalis superior.* The colica sinistra supplies the descending colon. The sigmoid branch supplies the sigmoid flexure of the colon. The superior hemorrhoidal descends between the laminæ of the mesorectum, running between the sacrum and the rectum, distributing to it numerous branches as far as the anus, and which anastomose freely with the other hemorrhoidal arteries.

The *lumbar* arteries, generally four, sometimes five, in number, proceed from the side and back part of the aorta outwards through the tendinous fibres of the psoas magnus towards the quadratus muscle and abdominal parietes. They give off, like the intercostals, a posterior branch, which, passing backwards, gives ramuli to the vertebræ, some to enter the intervertebral foramina, and others to the muscles of the back; the anterior branches, or continued trunks, supply the psoas, quadratus lumborum, and integuments, and anastomose with all the neighbouring arteries.

The *sacra media* passes downwards from the aorta, where it bifurcates, runs along the central line of the sacrum as far as the coccyx, in its course giving branches to the sacrum and rectum, and anastomosing with the hæmorrhoidal and lateral sacral arteries.

PELVIC VISCERA AND GENITAL ORGANS.

The organs or viscera contained within the pelvis are, in the male, the urinary bladder, the rectum, and part of the genital apparatus; in the female, the urinary bladder, rectum, and the uterus, with its appendages.

The *bladder*, or *vesica urinaria*, is situated in the anterior, inferior part of the pelvis, immediately behind the pubes when contracted, but, when distended, rises above the pubes, behind the recti muscles. It is pyramidal in shape; its apex, or *superior fundus*, is turned upwards and forwards, lies behind the recti muscles, and has attached to it the urachus; the base, or *inferior fundus*, is turned downwards and backwards, and rests on the inferior third of the rectum, partially separated from it by the prostate gland, vesiculæ seminales, and vasa deferentia: here a triangular space exists, bounded on each side by the vas deferens; its apex is in front, at the prostate gland, and its base is formed, posteriorly, by the cul-de-sac of the peritoneum: through this triangular space the bladder is sometimes tapped from the rectum. The *body* of the bladder lies between the superior and inferior fundus, it is rounded and slightly compressed from before backwards: its anterior surface corresponds to the posterior surface of the pubes and recti muscles, when distended; its posterior surface is covered by peritoneum, and is in contact with the small intestines, which separate it from the rectum; its lateral surfaces are related to the inner layer of the pelvic fascia, the levator ani muscles, and obturator vessels and nerves; along them ascend the umbilical arteries, and descend the vasa deferentia and ureters. The *cervix* or neck of the bladder is its anterior, inferior portion, where the urethra commences; it is surrounded by the prostate gland, and is conical in shape. A line drawn through the centre or axis of the bladder, and extended at either end, would touch the extremity of the coccyx inferiorly, and pass out anteriorly, ascending between the umbilicus and pubes. The bladder is surrounded, except posteriorly, by a quantity of loose cellular tissue, which allows it, when distended, to ascend out of the pelvic cavity.

The *ligaments* of the bladder are divided into the false and true. The *false* are folds of peritoneum, and are five in number, namely, two lateral, two posterior, and one superior. The lateral false ligaments are formed by the reflexions of the peritoneum, from the bladder to the side of the pelvis; each contains the vas deferens in the male, the ligamentum teres in the female. The posterior false ligaments are formed by the peritoneum passing from the bladder on the rectum; they are concave upwards and forwards, and contain the ureter and degenerated umbilical artery on each side. The superior false ligament is that portion of the peritoneum which covers the urachus and the remains of the umbilical arteries.

The *true* ligaments are folds of the pelvic fascia, and are four in number, namely, two lateral and two anterior. The *pelvic fascia* is a continuation of the iliac fascia, which, descending inwards behind the iliac artery, becomes attached to the ilio-pectineal line, and assumes the name of pelvic fascia. From the ilio-pectineal line, the pelvic fascia descends into the pelvis, and meeting with the upper margin of the levator ani divides into two layers: one of these, the external or obturator layer, descends on the outer surface of the muscle, lines the obturator internus, and becomes attached to the edge of the tuber ischii and rami of the ischium and pubis, where it is continuous with the triangular ligament; the inner or vesical layer of the pelvic fascia, descends along the inner surface of the levator ani, and is reflexed inwards from it on the lateral surface of the bladder, forming its *true lateral ligaments*. The *anterior true* ligaments stretch from the inferior edge of the pubes upwards and backwards, and are lost on the anterior surface of the bladder. These ligaments lie parallel, and are connected on their upper surface by a layer of fascia, on cutting through which an interval is found between them, in which are lodged the dorsal veins of the penis: they are continuous with the lateral ligaments. By the true ligaments the inferior fundus of the bladder is kept *in situ*, and prevented from rising out of the pelvis; they separate the cavity of the pelvis from the perineum, and thus prevent the diseases of either of those parts from passing freely into the other.

In *structure*, the bladder is composed of four coats: 1st, the serous or peritoneal; 2d, the muscular; 3d, the cellular; and 4th, the mucous. The serous is but a partial coat, it covers the superior fundus, as far forwards as the urachus, the whole of the posterior surface, the lateral surfaces as far as on a line with the posterior extremities of the vesiculæ seminales, and the inferior fundus to within about three quarters of an inch of the base of the prostate gland. The *muscular* fibres are of a reddish colour, and consist of three sets: 1st, the longitudinal; these extend from the anterior true ligaments upwards, on the anterior surface of the bladder, expanding towards the urachus, they thence descend along the posterior surface and inferior fundus to the base of the prostate gland; they are sometimes named the *detrusor* urinæ muscle: 2d, the oblique fibres; these are indistinct, and scattered on the lateral surfaces of the bladder: 3d, the circular fibres; these are best marked round the cervix, where they form a sphincter muscle, beneath the mucous membrane. There are intervals between the muscular fibres of the bladder, through which the mucous membrane sometimes becomes protruded, so as to form sacculi or pouches, in which calculi are not unfrequently lodged. The *cellular* coat of the bladder is strong and of a whitish appearance. The mucous membrane is of a pinkish colour, and presents irregular patches of vascularity, distinct from inflammation; it is thrown into rugæ or folds, in the contracted state of the organ.

Immediately behind the orifice of the urethra there is a triangular portion of the bladder, where the mucous membrane is smooth and pale; this is the *trigone vesicale;* the apex of this is in front, and is formed by the uvula; the base is concave, turned backwards, and is formed by a line drawn from the opening of one ureter to the other; the sides are formed by lines drawn from the ureters forwards and inwards to the uvula; beneath these a few muscular fibres exist, named *Bell's muscles*, the use of which is said to be to preserve the obliquity of the orifices of the ureters. The trigone is the most sensitive part of the bladder: beneath the mucous membrane covering this, an elastic structure is described; behind it the bladder forms a pouch (*bas fond*) in the adult, which is then the most depending part of the viscus. In this a calculus may be lodged, and thus elude the contact of the sound.

In its contracted state, the bladder does not rise above the pubes, its inferior fundus is then almost the only part uncovered by peritoneum, which presents itself to the knife of the surgeon. The bladder in the female is larger than in the male, it is also wider, and rests posteriorly on the vagina and uterus, which, with the small intestines, separate it from the rectum. In the child, the bladder is more cylindrical in shape, and reaches more into the cavity of the abdomen; its lowest part is its neck.

The *orifice* of the urethra is heart-shaped; from its base inferiorly, the uvula, a small fold of mucous membrane, projects.

The *urethra* commences at the neck of the bladder, and terminates at its external orifice, in the glans penis. It is divided into three portions, namely, the *prostatic*, *membranous*, and *spongy*. The prostatic portion is that which is surrounded by the prostate gland; it lies within the pelvis, is barrel-shaped, about one inch and a quarter in length, and runs downwards and forwards. In its interior and on its under surface is the *caput gallinaginis*, or *veromontanum*, a triangular projection of the mucous membrane, on which the common ejaculatory ducts open. On each side of this is the *sinus pocularis*, a depression, on which the ducts of the prostate gland open. The membranous portion of the urethra lies beneath the arch of the pubes, from which it is distant about three quarters of an inch, being separated by the apex of the triangular ligament and the sub-pubic ligament; it is about three quarters of an inch in length, passes through the triangular ligament, and runs forwards and a little downwards, being slightly curved, the concavity towards the pubes; it is, next to the orifice, the most contracted portion of the canal.

The spongy portion of the urethra commences at the bulb, and terminates at the orifice in the glans penis.

The *bulb* is a dilatation of the urethra, chiefly of its under part, and is best marked in the adult; it lies in front of the arch of the pubes, is connected to the anus, from which it is distant about three quarters of an inch, by the ano-urethral ligament, and is surrounded by the acceleratores urine muscles. From the bulb forwards, the urethra is nearly uniform as to size, except immediately behind the orifice, where it is slightly dilated, forming the *fossa navicularis*. The orifice is its most contracted portion. The spongy portion of the urethra is so called from being surrounded by a spongy erectile tissue, most abundant on its inferior and lateral surfaces; it is inclosed in a fibrous covering, derived from the triangular ligament, and is connected to the groove in the inferior surface of the body of the penis. The urethra is lined throughout by mucous membrane, and is generally smooth, with the exceptions already mentioned. Several small lacunæ open on it in a direction forwards; the largest of these are met with on its upper surface; one larger than the rest lies near the fossa navicularis, and is named the *lacuna magna.* The orifices of the lacunæ may entangle the point of a bougie, and thus be mistaken for stricture. Abscesses form in them in gonorrhœa.

THE MALE ORGANS OF GENERATION

Consist of the testes and their appendages, the vesiculæ seminales, prostate gland, Cowper's glands, and the penis. The *testes* are inclosed in the scrotum. The *scrotum* is composed of the skin, dartos, superficial fascia, tunica communis, and tunica vaginalis. The skin of the scrotum is thin, of a brownish colour, and scattered over with hairs; it is continuous on all sides with the surrounding integuments; through it, the veins of the scrotum may be seen. In diseases of the testes these veins are sometimes opened: the operation is performed by compressing the scrotum at its upper part with one hand, or a bandage, and then puncturing one or more of the largest veins with the lancet. On the mesial line of the scrotum is the *raphe*, produced by a thickening of the integuments; it is continuous behind with the raphe of the perineum, and is lost anteriorly in the under surface of the penis. The *dartos* is a thin layer of contractile fibres, lying beneath the skin: by some this structure is supposed to consist of vessels only; its use is to corrugate the scrotum. The *superficial fascia* lies beneath the dartos; it is composed of loose, areolar, cellular tissue, and allows of the ready infiltration of fluids, as of air in emphysema, water in anasarca, &c. The *tunica communis* is an expansion from the cremaster muscle.

The *tunica vaginalis* is a serous sac, which incloses each testis. It is separated from the one of the opposite side by the *septum scroti*, formed by a reflexion inwards of the superficial fascia, dartos, and tunica communis on the mesial line. The tunica vaginalis was, originally, a process of peritoneum, brought down by the testis, in its descent from the abdomen. Before the seventh month, this gland is lodged on the psoas muscle, below the kidneys, it then begins to descend along the inguinal canal, and finally passes into the scrotum, where it is usually found at birth, or immediately after. The process of the peritoneum which descends with the testis becomes generally closed, at its upper part, by the adhesive inflammation, by which the lower portion is cut off from the general peritoneal surface, and thus forms the sac of the tunica vaginalis. Should this obliteration not take place, a congenital hernia may be formed by the descent of a hernia into the tunica vaginalis, or a congenital hydrocele, by the effusion of fluid from its inner surface.

The tunica vaginalis covers the testis, except at its upper and back part; it is thence reflexed on the sides of the epidydimis, forming a cul-de-sac on the outer side, between the testis and epidydimis, from which it ascends, to a short distance, on the lateral and anterior surfaces of the chord; from the chord it passes off and lines the inner surface of the scrotum. The layer of the tunica vaginalis, which covers the testis, is called the *tunica vaginalis testis;* that which lines the scrotum, the *tunica vaginalis scroti.* This membrane is lubricated by a thin serous fluid, which allows of the free motion of the testis. It is the seat of the disease hydrocele.

Each testis is oval in shape, with the long axis directed obliquely downwards, backwards, and inwards; its upper extremity, turned a little outwards, is the larger; its outer surface is convex, its inner flattened; its anterior margin, directed also downwards, is free; its posterior or upper is covered by the epididymis, and is perforated by the vessels of the gland. The testis possesses two coats, an outer, partial one, as just described, from the tunica vaginalis; and an inner, fibrous one, named the *tunica albuginea,* which resembles the sclerotic coat of the eye, is of a whitish colour, and is composed of fibres interlaced together; from its inner surface several processes pass backwards to the corpus highmoniarum, forming the *mediastinum testis.* The inner surface of the tunica albuginea is lined by numerous vessels, forming a *tunica vasculosa.* The *interior* of the testis is composed of a soft, grayish, pulpy substance, formed of a number of small vessels, the *tubuli seminiferi,* loosely connected by cellular tissue: these are collected into bundles, separated by the processes which are sent off from the inner surface of the tunica albuginea; from these bundles about fifteen or twenty tubes pass, directly backwards, to the posterior part of the gland; these are called the *tubuli recti,* they enter the mediastinum testis, and then running between the two layers of the corpus highmoniarum form, with the vessels and nerves of the testis, the *rete testis;* from the upper part of this structure five or six tortuous vessels, the *vasa efferentia*, or *coni vasculosi*, penetrate the tunica albuginea, and arrive at the head of the epididymis; they here unite, and form one duct, the *vas deferens*, which, becoming convoluted on itself, forms the *epididymis*. This body applied to the upper and back part of the testis, and attached to it by the vessels and nerves of the testis, is composed of a *head* or *globus major* or upper extremity, a *body* or central portion, and a *tail* or *globus minor*, which forms its lowest extremity; from this the vas deferens escapes, and turning upwards ascends to the inner side of the epididymis, and enters the spermatic chord.

The testis is supplied with blood from the spermatic artery. This vessel arises from the front of the abdominal aorta, a little below the renal, sometimes, and more frequently, on the right side, from the renal artery; from this it descends outwards, in front of the psoas muscle and ureter, and behind the peritoneum, enters the internal abdominal ring, and is conducted by the spermatic chord to the upper and back part of the testis, where it perforates the gland, and is there lost in numerous branches, which terminate in the tubuli seminiferi and spermatic *veins*. These spermatic veins ascend from the testis, in the spermatic chord, where they wind round the spermatic artery, forming a plexus, the *corpus pampiniforme*, which, accompanying the artery, terminate in the vena cava on the right side, but in the renal vein on the left. The spermatic plexus of *nerves* arises from the renal plexus, the splanchnic nerves, and some filaments from the lumbar ganglia of the sympathetic; they soon join the spermatic vessels, and descend with them to the testis. The lumbar plexus also sends a few branches to the spermatic chord; these are directly lost in the cremaster muscle; one, larger than the rest, the *spermaticus superficialis*, is a branch of the ilio-scrotal nerve, and descends on the anterior surface of the chord.

The *spermatic chord* is thus formed of the veins, nerves, absorbents, and excretory duct of the testis, the vas deferens, united by fine cellular tissue, and inclosed in the *tunica vaginalis of the chord*, the degenerated portion of the peritoneum, and covered by the cremaster muscle. The vas deferens lies posterior in the chord, which it leaves at the internal abdominal ring; it here hooks round the epigastric artery, passes inwards, backwards, and downwards across the psoas muscle, and external iliac vessels, sinks into the pelvis, passing under the ureter and umbilical artery, applies itself to the false lateral ligament of the bladder, by which it is conducted to the inferior fundus of this organ, whence it runs forwards and inwards along the inner side of the vesicula seminalis, and, at the base of the prostate gland, terminates, by joining, at an acute angle, the duct of the corresponding vesicula, to form the *ductus ejaculatorius communis*, which, running forwards and inwards through the substance of the prostate gland, opens on the veromontanum. The vas deferens is composed of two coats, an external fibrous, and an internal mucous: the fibrous coat is of great strength, and gives to it the feel of whipchord; its cavity is exceedingly small. The vas deferens is flattened and convoluted, where it is connected to the inferior fundus of the bladder; its fibrous coat does not penetrate the prostate gland.

The *vesiculæ seminales*, two in number, are attached to the inferior fundus of the bladder, where they lie, one on each side, parallel and external to the vas deferens; they are about two inches in length, convoluted, oblong, and pyriform in shape: the larger extremity is obtuse, and turned backwards and outwards; their smaller extremity, directed forwards and inwards, terminates in a duct, which forms, with the vas deferens, the ductus ejaculatorius communis, as just described. Each vesicula is composed of an external fibrous or condensed cellular coat, and an internal mucous membrane. Their interior presents a sacculated appearance, not unlike that of the large intestines, the sacculi being smaller but more distinct. Their use is to contain the semen, and probably to secrete also a peculiar fluid, to assist in the process of generation. They form, with the vasa deferentia, the lateral boundaries of the triangular space, through which the bladder is sometimes punctured from the rectum.

The *prostate gland* surrounds the neck of the bladder and prostatic portion of the urethra, which passes through it, nearer its upper than its lower surface, one third of the gland only being *above* the canal. This gland is heart-shaped, the base, turned backwards, is notched in the centre, where the common ejaculatory ducts penetrate, separated by the middle lobe of the gland. The external surfaces of the prostate gland are surrounded by a plexus of veins, chiefly formed from the dorsal vein of the penis; they are convex, except on the under part, where a groove runs from behind forwards, dividing it into its two lateral lobes. This surface of the gland rests on the rectum. The prostate gland is covered by a dense fibrous capsule, which is derived from the triangular ligament, and gives to it its firm feel; its internal structure is composed of a congeries of mucous follicles, united by cellular tissue. Its use is to secrete a fluid, supposed to be useful in generation; this is conveyed into the urethra by means of numerous ducts, which open, some on its upper, but the greater number on its under surface, into the sinus pocularis, on each side of the veromontanum. The prostate gland possesses but three lobes; the two lateral, and the middle or Home's lobe.

The coverings of the *penis* are the skin, superficial fascia, and fascia of the penis. The *skin* is thin and loose, and is continuous with the surrounding integument. Anteriorly it is prolonged, so as to form a fold, named the *prepuce*, at the free margin of which the skin is reflexed on itself as far as the corona glandis; it thence covers the glans penis, where it is continuous, at the orifice of the urethra, with the mucous membrane; beneath this opening it forms a fold, the *frænum preputii.* The *superficial fascia* lies beneath the skin; it is loose and reticular, and is derived from a continuation of the superficial fascia of the abdomen, which descends from the pubes or the dorsum of the penis, forming the *false suspensory ligament;* anteriorly it is continued into the prepuce. The superficial fascia of the penis communicates freely with that of the perineum and abdominal parietes; hence effusions of serum, urine, &c. pass freely into its cells.

The *fascia of the penis* is a dense layer of cellular tissue, which invests the body of the penis, and is derived from the *true suspensory ligament*, a triangular fibrous structure, which descends from the margins of the arch of the pubis on the penis, inclosing between the two laminæ, of which it consists, the dorsal vessels and nerves of the penis.

The *body* of the penis is composed of the two *corpora cavernosa*, and the *corpus spongiosum urethræ.* Each corpus cavernosum commences by a narrow-pointed or sometimes obtuse extremity, which is attached to the inner surface of the tuber ischii, and rami of the ischium and pubes, whence, passing forwards and inwards, it terminates in the corpus cavernosum; this immediately unites with the corpus cavernosum from the opposite side; the two, thus united, pass forwards, and terminate behind the glans penis in a blind obtuse extremity. The corpora cavernosa are covered externally by a dense fibrous, whitish, elastic membrane, of some thickness; this sends in, on the mesial line, an imperfect septum, the *septum pectiniforme*, which partially separates the two bodies, but at the same time allows of a communication between their cells, particularly anteriorly. In the interior of this fibrous covering is an erectile spongy tissue, of a reddish colour, supposed by some to be composed of a congeries of arteries and veins; by others of cells, into which the blood is poured during the erection of the organ, whence it is afterwards removed by the veins. A peculiar set of arteries, which terminate in a cul-de-sac (*helicine arteries*), have been described of late. Between the corpora cavernosa, superiorly, a groove exists, in which the dorsal vessels and nerves of the penis run; a similar groove is seen on the under surface, in which is lodged the corpus spongiosum urethræ. This body completes the penis, and has been described with the urethra; it is covered externally by a fibrous membrane, which is derived from the triangular ligament of the urethra, within which is the spongy erectile tissue of the organ; this is of a dark blue colour, and is composed chiefly of veins; it is continued anteriorly in front of the extremity of the corpora cavernosa, where it expands and forms the *glans penis*: this body, conical in shape, is attached at its base to the summit of the corpora cavernosa by cellular tissue; it presents here a circular indentation, in front of which is a projecting edge, the *corona glandis;* these parts contain a number of sebaceous glands, the *glandulæ odoriferæ*, or *Tysoni.* The cells of the corpora cavernosa and corpus spongiosum urethræ do not communicate. The penis is supplied with blood by branches of the internal pudic arteries, as follows: 1st, *arteriæ dorsales penis*, run in the groove on the dorsum of the penis, and terminate by forming a vascular circle round the corona glandis; 2d, *arteriæ corporis cavernosi*, perforate the crura penis, and run forwards, on each side of and close to the septum pectiniforme; 3d, *arteriæ bulbi* vel *corporis spongiosi urethræ*, penetrate the bulb, and supply the corpus spongiosum urethræ. The *veins* of the penis pass backwards from the arteries, form a plexus round the neck of the bladder, and terminate in the internal iliac vein. The *nerves* of the penis are derived from the internal pudic, and accompany the arteries.

The erection of the penis is caused by the contraction of the erectores penis muscles, which force the blood forwards into the organ, and prevent the return of the venous blood. Dr. Houston of Dublin, describes a pair of muscles, the "compressores venæ dorsalis penis," which, arising on each side from the ramus of the pubes, cross the dorsal veins, and thus are enabled to compress them, and so contribute to the erection of the organ.

In amputation of the penis the course of the arteries should be borne in mind, so as to enable the operator to secure the bleeding vessels with ease. In hemorrhages from the penis, the division or tying of the dorsal arteries, or arteries of the bulb, sometimes becomes necessary.

Cowper's glands are two small bodies, which are lodged between the layers of the triangular ligament, in the angle between the membranous portion of the urethra and the bulb. They terminate in small ducts, which, passing forwards, open into the urethra in front of the bulb. Their exact use is unknown. They sometimes inflame in gonorrhea, and thus give rise to abscesses in perineo.

THE FEMALE ORGANS OF GENERATION

Are divided into the *external* and *internal.* The *external parts* are the *mons veneris*, *vulva*, *labia*, *clitoris*, *nymphæ*, *vagina*, and *perineum.*

The mons veneris is the projection in the front of the upper part of the pubes; it contains some fat beneath the integuments, and is covered with hair in the adult. The vulva is the cleft or fissure which extends from the mons veneris, backwards, to the perineum. The labia are folds of the skin, lined internally with mucous membrane, and between these containing some cellular tissue, which lie on each side of the vulva; they unite posteriorly, so as to form the *fourchette*, or commissure. The clitoris lies within the vulva, between the labia, immediately below the mons veneris; it is analogous to the penis in the male; it arises by two crura, one on each side, from the rami of the pubes, which unite to form one body, the clitoris, which, expanding in front, forms the glans clitoridis; this is partially covered with a fold of integument, called the prepuce. The clitoris is erectile, like the penis, but does not possess any canal. The nymphæ, or labia minora, descend from the prepuce downwards and outwards, and are gradually lost near the orifice of the vagina. Between the nymphæ, having the clitoris above and the orifice of the vagina beneath, is the external opening of the meatus urinarius, or *urethra*. This is about two inches and a half in length, and leads upwards and backwards, immediately above the vagina, into the bladder. The vagina lies beneath the preceding, and above the rectum; it leads upwards and backwards to the extent of about six inches, and terminates by surrounding the neck of the uterus, being prolonged farther on it posteriorly than anteriorly; it is lined internally by mucous membrane, which is rough and thrown into folds, chiefly in the transverse direction. It is generally partially closed in the virgin state near its anterior extremity by a crescentic fold of mucous membrane, concave upwards, named the *hymen*. The rupture or gradual obliteration of this leaves in the adult irregular projections, the *carunculæ myrtiformes*. External to the mucous membrane, the vagina is covered with a fibrous membrane, on the exterior of which is the *plexus retiformis*, composed chiefly of veins, and supposed to be erectile. The vagina receives a partial covering of peritoneum, near to its attachment to the uterus.

The perineum in the female extends from the fourchette to the os coccygis; it contains analogous muscles to the male, viz. the sphincter ani, levator ani, coccygæus, transversus perinei, and erector clitoridis. The *sphincter vaginæ* muscle may be said to correspond to the accelerator urinæ; it surrounds the orifice of the vagina, attached in front and superiorly to the clitoris, behind to central point of the perineum.

The internal organs of generation are the *uterus* and its appendages on each side, the *ligamentum teres, Fallopian tube*, and *ovary*.

The uterus lies between the bladder and rectum; it is pyriform in shape; the larger extremity is free and rounded, and is turned upwards and backwards; from this the uterus contracts to its cervix, which is surrounded by the vagina; from this it expands slightly within the vagina; it here presents a small transverse slit, the *os uteri* or *os tincæ*. This leads to the cavity of the uterus, which is small, and branches off at the superior and lateral parts into two lesser canals, which lead into the Fallopian tubes, all of which are lined by mucous membrane. In *structure*, the uterus is composed of a peculiar muscular tissue, perforated by numerous vessels; no distinct muscular fibres can be demonstrated in it, except in the impregnated state, and then only about the cervix, and near to the time of delivery. The uterus is covered by peritoneum, except where it projects into the vagina: this membrane forms on each side a large duplicature, the *broad ligament* of the uterus, which is reflexed from it on the sides of the pelvis: this ligament allows of the distension of the uterus during pregnancy, and contains in its upper margin the ligamentum teres, Fallopian tube, and ligament of the ovary, in order from before backwards. The ligamentum teres, the most anterior, stretches from the fundus of the uterus forwards and outwards, descends along the inguinal canal, and terminates by spreading out in the labia. The Fallopian tube, is about four or five inches in length; it runs from the fundus uteri, outwards and upwards at first, and then a little downwards and backwards, and terminates in a loose fringed extremity, the *corpus frimbriatum*, in the posterior surface of which is a small opening, the *morsus diaboli*, by which the cavity of the uterus communicates with that of the peritoneum, and where this serous membrane is continuous with the lining mucous membrane of the genital organs. The canal of the Fallopian tube is small near the uterus, but increases a little as it approaches the morsus diaboli; through it the ovum passes into the uterus from the ovary. The ovary is attached to the fundus of the uterus, by a round fibrous impervious chord, the ligament of the ovary, about two inches in length. The ovaria resemble the testes much, both as to size and shape; they are more irregular than these, and often present cicatrices, and the *corpora lutea.* The ovary is covered externally by peritoneum, beneath which is a strong, fibrous capsule, analogous to, but not so dense as, the tunica albuginea: within these, united by cellular tissue and vessels, is a number of vesicles, the *Graafian vesicles*, which contain the ova. The female organs are chiefly supplied with blood by branches from the internal iliac, viz. the vaginal and uterine. The latter, as also the uterine veins, become much enlarged during pregnancy. The ovaries are supplied by the spermatic arteries, which send a few branches to the uterus also. The nerves are derived from the sympathetic ganglia, and from the sacral plexus.

REGIONAL AND SURGICAL ANATOMY.

REGIONAL AND SURGICAL ANATOMY.

COVERINGS OF THE HEAD.

THE coverings of the brain, which serve to protect this delicate organ from injury, may be considered under the head of *the external soft parts; the osseous* or *bony case*, constituting *the cranium*; and *the internal soft parts*, comprising the cerebral membranes.

The external soft parts consist of the scalp, or pericranium, some loose recticular tissue, and the periosteum.

The *scalp* is covered naturally with a quantity of hair, varying much in different individuals and in different situations, which assists in lessening the effect of blows on the head; and, from hair being a bad conductor of caloric, it prevents those variations in temperature which, if transmitted suddenly to the brain, might be productive of injurious consequences. The *structure* of the scalp is composed of skin externally, and the occipito-frontal muscle and tendon more deeply seated. The *cuticle* is delicate and closely connected to the cutis, so that it is seldom raised in the form of vesication. The *cutis* is remarkably dense, and contains a number of sebaceous follicles, which are supposed to secrete an unctuous substance for the use of the hair. It is frequently the seat of encysted tumours and other morbid growths.

Beneath the cutis lies a layer of condensed cellular substance, containing a quantity of closely granulated fat, which connects the cutis to the occipito-frontalis tendon; in it, the bulbs of the hair are lodged, which externally perforate the cutis. Beneath this, and with difficulty separated from it, is the expansion of the occipito-frontalis tendon, a dense aponeurotic structure, which affords attachment to the four bellies of this muscle, two of which are anterior and two posterior. By some this is described as distinct from the muscle, under the name of *cranial aponeurosis*. However we describe it, the muscular fibres are closely connected with it, and thus the muscle causes it to produce the free motion of the scalp.

Wounds of this aponeurosis, and more frequently those of a punctured nature, are often followed by violent inflammation, which spreads to the subjacent cellular tissue, and gives rise to symptoms resembling those of inflammation of the membranes of the brain. The aponeurosis should be, in such cases, at once freely divided by an incision through it; this will relieve the tension, give exit to any matter that may have been formed, and cause the subsidence of the disagreeable symptoms.

The cranial aponeurosis covers only the superior and lateral regions of the cranium, reaching anteriorly as far as the coronal suture, and posteriorly to a little above the superior semicircular ridge on the occipital bone.

The scalp, or pericranium, is connected to or separated from the periosteum of the cranial bones by a quantity of loose reticular cellular tissue, which, from its great laxity and abundance, allows of the free motion of the soft parts on the convex surface of the cranium, and thus contributes much to the protection of the brain by eluding the violence offered.

Into this loose cellular tissue effusions frequently take place. In erysipelas of the head, serum is poured into it, giving rise to the œdematous condition of the scalp, a characteristic of this affection; and in the more advanced stages of the disease, matter forms in it. Blood is also poured into it, forming the bloody tumour of the scalp in the adult, and those remarkable swellings in the infant, after a tedious difficult labour, and which often spread over the whole surface of the cranium.

This is the only situation in the scalp where the fluids are effused.

The *periosteum* covers the external surface of the cranial bones, to which it is closely adherent, particularly along the sutures, by means of fibrous processes entering here, and of the vessels which enter at these situations to supply the bone, and anastomose in the diploe with the vessels of the dura mater. This is called the external periosteum, to distinguish it from the internal periosteum or dura mater.

In cases of severe injuries of the head, the external periosteum is frequently detached from the bone, or its vitality destroyed. This injury, if considerable in extent, will be followed by a necrosis or, more properly speaking, death and separation of the outer table of the skull; the remaining portion being supplied by the internal periosteum. More frequently, disease of the external periosteum is produced by inflammation, and that too of a syphilitic character, producing a swelling, distinguished by the name of node; here, if the inflammation be not subdued, necrosis of the outer table exposes the patient to a spreading of the inflammation to the dura mater, and may thus cause the death of the patient. The internal periosteum exerts more influence over the vitality of the cranial bones than the external, as, when the former becomes detached, either by disease or accident, a part or the whole substance of the bone perishes, the external periosteum becomes detached from its outer surface, and a tumour forms from the discharge that attends these processes, containing a sanious fluid mixed with air—this is known as Pott's puffy tumour of the scalp.

The scalp possesses a high degree of organization. It is supplied with blood by the *frontal*, *temporal*, *posterior aural*, and *occipital* arteries. The *frontal* arteries are branches from the ophthalmic; they escape from the cavity of the orbit, through the superciliary notch or foramen, along with the frontal nerves, and are lost in the anterior part of the scalp. The *temporal* arteries, one on each side, are derived from the external carotid, while in the substance of the parotid gland. They ascend, crossing the zygoma near its root, and immediately in front of the external meatus auditorius; send one branch to supply the temporal muscle; and then, after a short course, divide into two branches, an anterior and a posterior; these diverge, the anterior passing forwards to anastomose with the frontal artery, the posterior running backwards to join the posterior aural arteries. The branches of the temporal artery supply principally that part of the scalp known as the temporal region. The anterior temporal artery is frequently opened in cases where the rapid abstraction of blood becomes necessary, as in apoplexy, inflammation of the brain, &c.

The *posterior aural* artery is also a branch of the external carotid; it ascends behind the ear, and terminates by dividing into numerous branches, which supply the external ear and the scalp in its immediate neighbourhood.

The *occipital* artery is also derived from the external carotid; it enters the scalp, behind the sterno-mastoid muscle, ascends along the posterior surface of the cranium, where it supplies the scalp with numerous branches.

At first these arteries lie beneath the pericranium, but as they proceed, they break down into numerous branches: some of these take a superficial course, perforate the cranial aponeurosis, and supply the cutis and bulbs of the hairs, whilst others pass to the periosteum, and are finally distributed to the bones, where, in the diploe, they anastomose with the branches of the meningeal arteries. All the terminal branches of these arteries anastomose freely with each other, and with the meningeal arteries, a fact of much importance, as it serves to explain the tendency there is always to inflammation of the brain and its membranes, where the external parts have become diseased or have been injured.

The *nerves* of the scalp are the *frontal*, which accompany the arteries of the same name, and are derived from the first division of the fifth; the *temporal*, which accompany the temporal artery in great numbers; they are derived from the fifth, the portio dura of the seventh, and the cervical plexus; and branches from the first cervical (not suboccipital) which accompany the occipital arteries.

The *osseous case*, which incloses the brain, and is generally known under the name of cranium or skull, is well adapted to protect the organ from injury, in consequence of the number of bones which enter into its formation, mutually supporting each other, and presenting an arched shape.

The *internal soft parts* are the dura mater, the arachnoid, and the pia mater, and are described with the brain and nervous system.

On the *lateral surfaces* of the cranium we meet with the muscles of the external ear. They are three in number, are small, and often imperfectly developed. Few individuals possess any control over these muscles.

THE NECK.

The neck, on each side, is bounded by the clavicle below, the lower jaw above, and a line drawn from it to the mastoid process, in front by the mesial line, and posteriorly by the edge of the trapezius. Immediately beneath the integuments crossing the lateral surface of the neck and connected to them by cellular tissue, lies the *platysma myoides* muscle. The fibres of the muscle vary much in different individuals, being in general best marked in the female; they take a direction upwards and inwards, or from the shoulder towards the chin.

On raising the platysma-myoides muscle, the *external jugular vein*, *some branches of nerves*, the *cervical fascia*, and the principal muscles of the neck are brought into view.

The *external jugular* vein is formed, in the substance of the parotid gland, by the junction of the internal maxillary and temporal veins; from this it descends, nearly in the vertical direction, but inclining somewhat backwards, crosses the outer surface of the sterno-mastoid muscle, and at the posterior margin of this muscle, a short distance above the clavicle, it dips into the subclavian vein, in the posterior inferior triangle of the neck. At the upper part of the neck, the external jugular vein is small in size, but as it descends it increases considerably, especially a little above its termination, from its receiving the blood from many superficial veins in this region. In general it communicates by a transverse branch with the internal jugular vein. Not unfrequently a second external jugular vein is met with near the mesial line of the neck: this is called the anterior jugular vein; where it exists, it almost constantly communicates, by a branch which crosses the sterno-mastoid muscle, with the external jugular vein, which is in such cases smaller than usual. When a corresponding branch exists on the opposite side, the two veins unite in front of the trachea and immediately above the sternum, so as to form an arch, the convexity of which is directed downwards, a variety that will embarrass the surgeon not a little, should he be called on to perform the operation of tracheotomy; they terminate in the venæ innominatæ or internal jugular veins. The external jugular vein, where it crosses the sterno-mastoid muscle, is accompanied by a nerve, the *superficialis colli*, a branch from the cervical plexus, which winds round the posterior margin of the muscle, ascends along its outer surface, parallel to but about half an inch above the vein, and is lost in the integuments covering the parotid and temporal regions and those of the ear.

The external jugular vein is frequently opened in children when attacked with croup, convulsions, or other diseases, for the relief of which the rapid abstraction of blood is deemed necessary. It is the best vein for the purpose at the early periods of life, as then the other subcutaneous veins are but small, and are obscured from view by the adipose tissue, so abundant beneath the integuments in the young subject. It may be opened in the following manner:

Turn the head of the patient to the opposite side, so as to make the vein project as much as possible, make pressure with the thumb or finger over the course of the vein, a little above the clavicle, so as to impede the flow of blood from it into the subclavian vein. As soon as it appears sufficiently prominent, make an incision through the integuments and platysma-myoides, over the vein, where it crosses the sterno-mastoid muscle, as here the vein is most superficial, being thrown outwards by the muscle. The incision should be about half an inch in length, to be directed upwards and backwards, or in the course of the sterno-mastoid muscle; as by this means the fibres of the platysma will be cut across, and the wound will be rendered more patulous by the contraction of the divided muscular fibres. If the incision be made in the direction of the fibres of this muscle, they will contract, and so close the wound, and prevent the escape of the blood externally, which thus may become extravasated into the cellular tissue of the neck. Having by this incision exposed the vein, it is now to be opened to a sufficient extent, when the blood will flow. As soon as the required quantity has been abstracted, the pressure at the lower part of the vein is to be discontinued, when the bleeding will in general cease; the edges of the wound are then to be brought together by adhesive straps, and united by the first intention.

Some prefer opening the vein in the first incision. In performing this operation, the superficialis colli nerve will be much endangered, if the incision be extended too much upwards, towards the mastoid process.

When operating at the root of the neck, either in the removal of tumours or in tying the subclavian artery in its third stage, the external jugular vein should be avoided, if possible, as, independently of the hemorrhage that will follow its division here, fatal consequences have resulted from the atmospheric air being drawn into the vein during inspiration, or from the inflammation to which all large veins, when cut, are so prone. If divided here, it will be necessary to tie the vein in order to arrest the hemorrhage; in many cases both ends of the vessel will require to be secured, as blood will escape from its lower as well as from its upper extremity; here, air is most likely to enter.

The *cervical fascia* is a dense layer of aponeurotic structure, which covers the lateral surface of the neck, binding down the muscles, and forming sheaths for them, in which the greater portion of them is inclosed. If we examine the cervical fascia, at the posterior part of the neck, immediately in front of the trapezius muscle, it is weak and cellular; from this it passes forwards, becoming more condensed; having arrived at the posterior margin of the sterno-mastoid muscle, it divides into two layers, which inclose this muscle between them; one passing on its superficial the other on its deep surface, hence called the superficial and deep layers of the cervical fascia. The superficial layer is gradually lost towards either attachment of this muscle, passing inferiorly over the clavicle, and superiorly on the mastoid process; the deep layer, on the contrary, is attached inferiorly to the posterior surface of the clavicle, and is here continuous with the sheath, derived, by the great vessels at the root of the neck, from the fibrous layer of the pericardium. The two layers of the cervical fascia reunite at the anterior margin of the sterno-mastoid muscle, pass forwards, and become continuous with the sheath of the carotid vessels; from this they pass towards the mesial line of the neck, forming sheaths for the sterno-hyoid and thyroid muscles, and are continuous with those of the opposite side. In the centre of the neck, in front of the larynx and trachea, the cervical fascia is not well marked.

Inferiorly, the cervical fascia descends towards the sternum; as it approaches the bone, it becomes remarkably strong, and is finally implanted into the upper margin of the sternum, and into the interclavicular ligament. Its great strength here is of use in preserving the trachea from the pressure of the atmospheric air. Superiorly, the cervical fascia is well marked; on the mesial line it is attached to the lower margin of the symphysis of the lower jaw: as we trace it from this backwards, it arrives at the submaxillary gland; here it divides into two layers which inclose this gland between them, so as to form for it a distinct capsule; these layers pass upwards, and are inserted into the inner surface of the inferior maxilla; behind this it sinks deeply into the neck, and becomes attached to the angle of the jaw and styloid process of the temporal bone, forming the stylo-maxillary ligament. Still more posteriorly, the cervical fascia ascends over the outer surface of the parotid gland, to which it thus gives a partial investment, sending, at the same time, processes into the gland which separate the acini of the gland, and give to it its irregular granular appearance. This, the *parotid layer* of the cervical fascia, is attached superiorly to the zygoma, posteriorly to the meatus auditorius externus, and anteriorly is lost on the masseter muscle.

Posteriorly to the parotid gland, the cervical fascia becomes indistinct, and is lost, as already described. The cervical fascia is of use in forming a covering for the lateral surface of the neck, in binding down the cervical muscles and vessels for which it forms sheaths.

In a practical point of view it is of much importance. From the number of glands in the neck, this region is frequently the seat of abscesses and other tumours. When abscesses form beneath the fascia, they are resisted by it from breaking externally; they will, therefore, if not given exit to by the knife of the surgeon, burrow beneath the fascia, and finally open at some distant region, where the fascia is less strong, thus forming sinuses distressing to the patient and difficult of cure. Our practice should be to open these abscesses early, and thus prevent such mischief taking place. In cases of tumours of a more chronic character forming beneath the cervical fascia, whether enlargement of the glands, or aneurismal swellings, the fascia will have a similar effect in restraining them from coming to the surface, and, in cases of aneurism, may render their pulsation somewhat indistinct. One remarkable effect is produced by the existence of tumours beneath the cervical fascia, namely, difficulty of breathing, sometimes amounting to suffocation, caused by the tense condition of the fascia resisting the free motion of the larynx and trachea, and doubtless also by the mechanical pressure of such tumours on those important parts, as well as by the sympathetic irritation communicated to the laryngeal muscles. In such cases, our practice is to remove the swellings by appropriate treatment; if they be caused by a collection of pus, this should be given exit to by a free division of the fascia; but if by an aneurismal tumour, the artery should be tied, or some other means adopted for relieving the patient. Another reason for the early opening of abscesses beneath the cervical fascia, is derived from the circumstance of their occasionally bursting into some of the large veins of the neck, or into the larynx, thus causing death, either by suffocation or by the injurious consequences which result from the purulent matter mixing with the circulation.

When the cervical fascia is removed the lateral surface of the neck is completely exposed; this is of a quadrilateral shape, and is bounded above by the ramus of the jaw, and a line leading from it to the mastoid process; below by the clavicle; in front by the mesial line, extending from the chin to the sternum; and behind by the anterior margin of the trapezius muscle. This quadrilateral region is divided, by the sterno-mastoid muscle, into two great triangles, named the anterior and posterior triangles of the neck.

The *anterior triangle* has its base above formed by the ramus of the jaw, and a line leading from it to the mastoid process; its apex is below, and is formed by the sterno-mastoid muscle approaching the mesial line of the neck; its anterior boundary is formed by the mesial line; its posterior by the anterior edge of the sterno-mastoid muscle.

The *posterior triangle* of the neck has its base below, formed by the clavicle; its apex is turned upwards, and is truncated and formed by the sterno-mastoid muscle approaching the trapezius; its posterior boundary is formed by the trapezius muscle; its anterior by the posterior edge of the sterno-mastoid.

Each of those triangles is subdivided, by the omo-hyoid muscle, into two lesser triangles; namely, the posterior superior, the posterior inferior; the anterior superior, and the anterior inferior.

The *posterior superior* triangle is the largest, but the least important; its apex is at the decussation of the omo-hyoid and sterno-mastoid muscles; its base at the anterior edge of the trapezius; its superior boundary is formed by the sterno-mastoid; its inferior by the posterior belly of the omo-hyoid In it are contained the transversalis colli artery, the cervical plexus, the spinal accessory nerve, a quantity of glands, and some cellular tissue.

The *posterior inferior* triangle is bounded below by the clavicle, which forms its base; its apex is at the decussation of the omo-hyoid and sterno-mastoid muscles; its posterior boundary is formed by the posterior belly of the omo-hyoid; its anterior by the sterno-mastoid. This triangle is exceedingly small when its boundaries are not disturbed from their natural position, as the posterior belly of the omo-hyoid ascends but little above the clavicle. In it we have the subclavian artery, in its third stage, the transversalis colli and transversalis humeri arteries, the subclavian and external jugular veins, some branches of the cervical plexus, the brachial plexus, some glands, and cellular tissue.

The *anterior inferior* triangle has its apex at the juncture of the omo-hyoid and sterno-mastoid muscles; its base is formed by the mesial line of the neck; its posterior boundary is the sterno-mastoid; its superior, the anterior belly of the omo-hyoid muscle. In it are contained the carotid artery in its first or deep stage, the internal jugular vein, and par vagum, and the lateral lobe of the thyroid gland.

The *anterior superior* triangle may be subdivided into two triangular spaces by the os hyoides; that below the bone being named the infra-hyoid space, that above it the supra-hyoid or digastric space. The *infra-hyoid* space has its apex at the decussation of the omo-hyoid and sterno-mastoid muscles; its base is turned upwards, and is formed by the cornu of the os hyoides and digastric muscle; its anterior boundary is formed by the anterior belly of the omo-hyoid; its posterior by the sterno-mastoid. It contains the carotid artery in its superficial or second stage, the internal jugular and facial veins, the pneumo-gastric, and descendens noni nerves. The *digastric* or *supra-hyoid* space will be described hereafter.

Let us now turn our attention to the muscles exposed in this stage of the dissection: they are the sterno-mastoid, the omo-hyoid, the sterno-hyoid, and the sterno-thyroid.

The *sterno-mastoid muscle* crosses the neck, in the diagonal direction, from the sternum and clavicle to the mastoid process. Near the sternum a triangular space exists between the two origins of the muscle, through which the subclavian vein and artery may be wounded. The anterior margin of this muscle serves as our guide in cutting down on the common carotid artery. Inferiorly, this vessel is overlapped by the sternal portion of the muscle; but, as the muscle ascends, it retreats backwards from the artery, and thus leaves it covered only by the skin, platysma, and cervical fascia. The spinal accessory nerve perforates the sterno-mastoid muscle a little above its centre, giving to it a few filaments.

The *omo-hyoid* muscle crosses the neck also, but in a contrary direction; it ascends from behind forwards, from the scapula to the os hyoides; it therefore decussates the sterno-mastoid, and thus forms the several triangles of the neck: it is a digastric muscle, its tendon lying behind the sterno-mastoid. The omo-hyoid is of much use in guiding us in our several operations on the common carotid artery, and on the subclavian in its third stage. It crosses the scaleni muscles, the brachial plexus, the phrenic and sympathetic nerves, and the sheaths of the carotid vessels.

The *sterno-hyoid* and *sterno-thyroid* muscles are situated in front of the trachea, larynx, and thyroid body. As these muscles ascend from the sternum to their insertions, they take a somewhat contrary course, that is, the sterno-hyoid converge, whilst the others diverge. Between the muscles of either side, on the mesial line, a cellular line exists, in which our incisions are made in the operations of tracheotomy and laryngotomy. Inferiorly, these muscles, and particularly the sterno-thyroid, from their great breadth, overlap the carotid artery; this vessel, however, passes backwards from beneath them as it ascends. Connected with the origins of these muscles, the terminating filaments of the descendens noni nerve may be seen. On raising these muscles, the carotid sheath, the larynx, trachea, and thyroid body are exposed; and, by a little further dissection, the cervical and brachial plexuses, and the subclavian vessels will be exposed; the cervical plexus being situated at the upper and posterior part of the neck, the others near its root, a short distance above the clavicle.

The *thyroid body* or *gland* is a large, soft, reddish mass, which lies in front of the trachea, and along the sides of the larynx. It is crescentic in shape, the concavity being turned upwards, and consists of three lobes, a middle or central, and two lateral. The middle or central connects the two lateral lobes; it is small and flat, and lies on the second, third, and fourth rings of the trachea, and to which it is attached by cellular tissue. The lateral lobes are much larger: they lie on each side of the larynx and trachea; narrow and pointed above, they reach as far the alæ of the thyroid cartilage; convex and rounded below, they extend to within a short distance of the sternum. Their cutaneous surface, convex, is covered by the sterno-hyoid, thyroid, and omo-hyoid muscles; the posterior surface, flattened and concave, rests on the trachea in the mesial line, and on either side overlaps the carotid artery, inferior thyroid vessels, the recurrent nerve, the crico-thyroid muscle, and the inferior constrictor of the pharynx. The left overlaps also the œsophagus.

The thyroid gland is best marked in the female, and in the young subject, but varies much as to size in different individuals. It is covered externally by a thin layer of cellular substance, within which it is composed of a number of minute cells, which secrete a yellowish, serous, and somewhat viscid fluid, the use of which is wholly unknown, as no excretory duct has as yet been discovered from the gland. The thyroid body is largely supplied with blood by the superior and inferior thyroid arteries on each side. The former are derived from the external carotid, the latter from the thyroid axis; these vessels anastomose freely in the substance of the gland, and terminate in veins which return the superfluous blood. These descend principally from the inferior margin of the gland, in front of the trachea, where they form a plexus, the *thyroid plexus*, which empties its blood into the left vena innominata. Its nerves are derived from the sympathetic and pneumo-gastric. In the fœtus the thyroid gland is in general connected inferiorly to the thymus gland.

The thyroid gland is of much importance in a practical point of view. It is subject to a species of chronic enlargement, termed bronchocele, or goitre, which appears to be a dilatation of the cells, of which the gland is, in its normal state, composed. This enlargement, in general, affects all its lobes, but may be confined to one. In many cases it increases to such an extent as to form a large pendulous tumour, overlapping the sternum. This disease is not dangerous. It is best treated with the various preparations of iodine. Sir E. Home has recommended the tying of the thyroid arteries for its removal, but this operation has now been abandoned in consequence of the danger attending it, and still more from the very partial success which has followed its adoption. The removal of the tumour by the knife has also been recommended. This operation, although perfectly practicable, is rarely called for, as the swelling is seldom injurious to life or health; indeed, in some countries, it is much admired in females. Where the patient is anxious for its removal, the passing of setons through it would most probably cause the obliteration of the cells, and thus at least diminish considerably the swelling, if not restore it to its original size. In some cases the middle lobe of the thyroid gland has been found to pass between the trachea and œsophagus, or even behind this tube. The effects of enlargement of it under such circumstances would be serious indeed. From the relation of the thyroid body to the carotid artery, pulsation may be communicated to it when enlarged, and thus the disease be mistaken for aneurism of the vessels. Inflammation and its consequences, suppuration, &c., seldom affect the thyroid gland. It is liable, however, to malignant diseases. When performing the operations of tracheotomy and laryngotomy, this gland, as well as its numerous vessels, should be avoided, as they pour out a large quantity of blood, and embarrass the operator considerably. It is particularly developed in children, in whom it descends so as nearly to touch the sternum, and unite with the thymus gland.

The *carotid sheath* is a layer of condensed cellular membrane, which incloses within it the carotid artery, the internal jugular vein, and the pneumo-gastric nerve. It is partly derived from the cervical fascia, to which it is closely attached, and partly from the fibrous sheath, which the large vessels at the root of the neck receive from the fibrous layer of the pericardium. Superiorly, it is indefinitely lost on the vessels and on the surrounding structures.

On opening it, the carotid artery will be found within it, having the internal jugular vein to its outer side; behind and between these vessels lies the par vagum. The sheath is covered in the lower part of the neck by the integument, platysma, the cervical fascia, the sterno-mastoid, the sterno-hyoid, and thyroid muscles; above this by the integument, platysma, and cervical fascia only. Between those points it is crossed by the anterior belly of the omo-hyoid. In front of it descends the descendens noni nerve, a branch from the lingual which, after a short but variable course, anastomoses with a branch of the second cervical nerve, with which it forms a plexus or nervous arch, the convexity of which is directed downwards; from this several filaments descend to the sterno-hyoid, thyroid, and omo-hyoid muscles. To the outer side of the sheath, lies the sterno-mastoid muscle; to the inner side, the trachea and larynx, the œsophagus and pharynx, the thyroid gland, the superior and inferior thyroid arteries, and the superior and inferior laryngeal nerves. Behind, it rests on the spinal column, with the intervention of the sympathetic nerve, the rectus capitis anticus major and longus colli muscles; and inferiorly, the inferior thyroid artery.

THE COMMON CAROTID ARTERIES

Arise, the *right* from the arteria innominata, opposite the right sterno-clavicular articulation; the *left*, from the arch of the aorta, between the origins of the arteria innominata and the left subclavian. From these different origins, these vessels ascend backwards and outwards into the neck, contained, with the par vagum and internal jugular vein, in the carotid sheath; and, having arrived opposite the os hyoides or the upper edge of the thyroid cartilage, each divides into the external and internal carotid arteries. In the first part of their course these vessels differ in several particulars. From its peculiar origin, the left carotid lies inferiorly within the thorax, and is here covered by the sternum, the left vena innominata, and the remains of the thymus gland, and rests on the trachea, a little above the bifurcation of this tube; and, escaping to the left side of the trachea, it lies on the thoracic duct and œsophagus, whence, ascending into the neck, it resembles the right carotid artery. The left carotid artery is longer than the right, lies deeper in the root of the neck, and is in general somewhat smaller.

The course of the common carotid artery in the neck is divided by the omo-hyoid muscle into two stages, viz. an inferior or deep; a superior or superficial. In the inferior or deep stage, the artery lies in the anterior inferior triangle of the neck, covered by the skin, platysma, fascia, sterno-mastoid, hyoid, and thyroid muscles, and the carotid sheath; to its inner side lie the trachea and left recurrent nerve; on the left side, the œsophagus; to its outer side, the par vagum and internal jugular vein; and behind it, the posterior part of the sheath, behind which are the inferior thyroid artery, the recurrent and sympathetic nerves, the longus colli, and rectus capitis anticus major muscles. There is some difference in the relation of the internal jugular vein to the common carotid artery, in this stage, on the right and left sides. On the right side the vein, as it descends to join the subclavian, diverges from the artery so as to leave an interval between them, and form, with the subclavian artery inferiorly, a vascular triangle, in which the par vagum and cardiac filaments of the sympathetic nerve descend to cross the subclavian artery, and in which, more deeply seated, the vertebral artery ascends. On the left side, on the contrary, the vein, as it descends to join the left subclavian, approaches the left carotid artery, so as to overlap it a little. This difference in the relation of the internal jugular vein adds much to the difficulty of securing the carotid and subclavian arteries on the left side.

In the superior or superficial stage, the common carotid artery lies in the anterior superior triangle of the neck; it is here covered only by the skin, platysma, and cervical fascia and sheath, on the outer surface of which is the descendens noni nerve; but, occasionally, this nerve is met with within, or even behind, the sheath. To the inner side of the artery, in this stage, are the larynx and pharynx, superior thyroid artery, and superior laryngeal nerve. To its outer side are the par vagum and internal jugular vein; behind it, the sympathetic nerve, and the longus colli and rectus capitis anticus major muscles. In the centre of the neck the carotid artery is slightly overlapped by the lateral lobe of the thyroid gland. Should this become enlarged, it is possible that it may be mistaken for an aneurism of the vessel. This is not the only tumour which may lead to error, numerous lymphatic glands accompanying the artery in the neck, particularly on its outer side; these are extremely liable to chronic enlargement, and may, under such circumstances, should they approach the artery, be mistaken for an aneurism.

As the common carotid arteries are supported posteriorly by the cervical portion of the spinal column, they may be compressed for a short time against this structure during life, in cases of hemorrhage, from the vessel itself or from any of its principal branches, until more effectual means shall have been adopted for restraining the hemorrhage. It has been also suggested to compress the arteries here, in cases of threatening apoplexy, so as to lessen the quantity of blood sent to the brain; the practice is objectionable on account of our being unable to avoid, at the same time, compressing the jugular vein, and thus retarding the flow of the blood from the brain.

The carotid artery may be tied in its first or deep stage, for the cure of aneurism affecting it in its superficial stage, also when wounded, and for the cure of aneurism of the arteria innominata, in the distal operation. The operation is performed in the following manner:

Place the patient in the recumbent posture, then, turning the head towards the opposite side, and but moderately extending the neck, make an incision, about three inches in length, through the skin and platysma, along the inner edge of the sterno-mastoid muscle, commencing inferiorly close to the sternum. Cut through the fascia, avoiding any veins that may be present. The inner edge of the sterno-mastoid is exposed, as also the sterno-hyoid and thyroid muscles, with a few branches of the descendens noni nerve; draw the mastoid muscle to the outer side, the others to the inner or tracheal side, or if necessary cut across some of the fibres, on a director passed beneath them. The sterno-thyroid, from its greater breadth, overlaps the artery, and will most likely require division. The muscles having been drawn out of the way, or divided if necessary, the sheath is brought into view, having the omo-hyoid muscle crossing it at the upper part of this region. Open into the sheath by pinching it up between the fingers, making a small incision into it with the knife held in the horizontal direction; into this opening introduce a director, and on this divide the sheath to the required extent. The carotid artery will be now exposed, with the vein and nerve; detach the artery gently from its surrounding connexions, with the end of a probe or director, and pass the aneurism needle under it from without inwards; in doing so, avoid the par vagum and vein to the outer side, the sympathetic nerve, inferior thyroid artery posteriorly, and the recurrent nerve on the inner side. If the left carotid be the subject of the operation, the thoracic duct and œsophagus should also be avoided.

The internal jugular vein has been found to embarrass the surgeon much, from its alternately flapping over and receding from the artery, a motion communicated to it by the regurgitation from the right auricle, as well as from the act of respiration, all the large veins at the root of the neck being emptied when inspiration takes place, and being on the contrary distended during the act of expiration. The extent of this embarrassment has been variously stated by different operators, some asserting that it has been considerable, whilst others assert that the vein gave them little or no trouble. In fact, it must vary according to the situation where the artery is tied; thus, it is likely to give but little trouble on the right side, at the lower part of the neck, whilst, in almost every other situation, it cannot fail to be troublesome. To remove the cause of annoyance the vein should be compressed both above and below.

The ligature having been passed round the artery, without including any of the surrounding parts, and properly secured, one end may be cut short, and the other allowed to hang out of the wound, this being closed by adhesive plaister. After the operation, the patient's head and neck should be supported on a pillow, so as to relax the muscles as much as possible.

The carotid artery is tied in the superior or superficial stage, when wounded here, as in cases of attempted suicide, or for the cure of aneurism of the internal or external carotid arteries, or any of their principal branches, or for aneurism of the first stage, according to the distal operation. It has been also recommended to be tied in cases of hemorrhage from the external carotid, or any of the principal branches when wounded; if possible, the wounded artery itself should be tied, and if this cannot be accomplished, the trunk nearest to the wounded branch should be secured. Where hemorrhage takes place from deep ulcers of the tongue, it has been found necessary to tie the external, or common carotid; the former should, for obvious reasons, be preferred. Some have advocated tying the common carotid artery, for the cure of large aneurisms by anastomosis affecting one or more of the principal branches of the external carotid. Experience, however, has proved that such treatment is ineffectual, owing to the free anastomosis of these branches, which carry on the disease, although the main artery may have been secured.

The operation of tying the common carotid, in its superior or superficial stage, is performed as follows:

Place the patient in the recumbent posture, turning the head to the opposite side, and slightly extending the neck; make an incision about three inches in length, along and a little internal to the anterior margin of the sterno-mastoid muscle, and extending from a little beneath the angle of the jaw to the side of the cricoid cartilage. In this the integuments and platysma are divided, and the cervical fascia exposed; divide this cautiously on a director, taking care to avoid the veins, and particularly the labial or facial, which crosses this part of the neck to open into the internal jugular vein, and also the descendens noni nerve, which lies here in general on the anterior surface of the sheath. Open into the sheath as directed in the preceding operation, and proceed to pass the aneurism needle round the artery from without inwards, avoiding the par vagum and internal jugular vein externally, the sympathetic nerve posteriorly, and the superior laryngeal nerve and superior thyroid artery on the inner side.

The common carotid artery should always be secured, if possible, at some distance from its bifurcation, as the origins of the external and internal carotids are likely to prevent the formation of the coagulum in the interior of the vessel when secured near to this point.

The common carotid artery bifurcates opposite the os hyoides, or superior edge of the thyroid cartilage, into

THE EXTERNAL AND INTERNAL CAROTID ARTERIES.

These vessels are nearly equal in size in the adult, but in the fœtus, the internal carotid is larger, as the brain which it supplies is well developed, whilst the face, which is supplied by the branches of the external carotid, is but little advanced in its formation. These vessels are named from the parts to which they are distributed, the internal supplying the brain, the external the face and external regions of the cranium, but not from their relative position. Let us consider, first,

The external carotid artery. This vessel lies, at its origin, anterior and internal to the internal carotid; it first passes upwards and inwards towards the submaxillary gland, then passes backwards behind the angle of the jaw, and finally enters the substance of the parotid gland between the ramus of the jaw, and the external meatus auditorius, where it terminates, about midway, between the angle of the jaw and the zygoma, but somewhat nearer the latter, by dividing into the internal maxillary and temporal arteries. In its course, the external carotid is somewhat curved, the convexity directed inwards, towards the pharynx and tonsil, and is, comparatively speaking, superficial, except whilst lodged in the parotid gland. The external carotid artery, a little after its origin, is crossed by the digastric and stylohyoid muscles.

It may be usefully divided into three stages, the *first* being from its origin to where it is crossed by the digastric muscle; the *second*, from this point to its entrance into the parotid gland; the *third*, whilst it is lodged in the gland.

In the first and second stages, the external carotid is superficial, being covered only by the integuments, platysma, and cervical fascia; a little below the digastric muscle it is crossed by the lingual nerve, which here hooks round the occipital artery. At its commencement, it rests on the superior laryngeal nerve, the pharyngeal plexus, and some cellular tissue, which connects it to the internal carotid and side of the pharynx; above this, and near the angle of the jaw, it is supported by the stylo-glossus and stylo-pharyngeus muscles, the glosso-pharyngeal nerve, and a portion of the parotid gland, all of which parts separate it from the internal carotid. Immediately after the origin of the external carotid, the internal jugular vein leaves it to accompany the internal carotid; above this point the external carotid artery is accompanied by two veins, one on either side.

In its third stage, the external carotid artery lies deep in the substance of the parotid gland, through which it ascends obliquely outwards as it approaches the zygoma.

It is here crossed by the portio dura nerve, which, escaping from the stylo-mastoid foramen, passes through the gland from behind forwards and outwards, separated from the artery by a portion of the gland, and by the external jugular vein. The nerve here forms a plexus, the pes anserinus, from which branches pass off to supply the side of the temple, face, and neck.

This nerve is sometimes divided, immediately after its exit from the stylo-mastoid foramen, for the cure of tic doloureux; it is exposed by making an incision, about two inches in length, along the anterior edge of the mastoid process and sterno-mastoid muscle; and then dividing between them and the gland, to the depth of about one inch and a quarter, when the nerve is exposed, and may be cut across. In performing this operation, the posterior auris artery is necessarily divided. The division of nerves, for the cure of tic doloureux, is now almost abandoned from the want of success that has followed this operation. This has been attributed by some to the ends of the nerves being left in apposition, by others, to the branches of the nerve, given off by the nerve previously to its division, causing the disease, as we consider this disease to be situated, in many cases at least, in the bony canal, through which the nerve passes.

The external carotid may be tied without difficulty, either in its first or second stages, by making an incision, about two and a half or three inches in length, through the skin, platysma, and fascia, extending from beneath the lobe of the ear, downwards and inwards, towards the cornu of the os hyoides; by this, the digastric muscle will be exposed: this guides us at once to the artery which may be brought into view, either above or below this muscle, with very little dissection. This proceeding may be required in performing operations about the ramus of the jaw, where some of the branches of the external carotid are, or are likely to be, wounded, as also in cases of hemorrhage from those vessels, or from deep ulceration or sloughing about the jaw or mouth; we need hardly remark, that the artery should be tied between the heart and the origin of the branch from which the hemorrhage proceeds. The external carotid artery is sometimes wounded in attempts at suicide; here we should dilate the wound, if necessary, and tie both ends of the bleeding vessel.

In its third stage, the external carotid is nearly precluded from interference, except the extirpation of the parotid gland. Before proceeding to this operation, it is judicious to secure the trunk of the common carotid.

The branches of the external carotid artery are ten in number, and are divided into the anterior, posterior, and ascending; the *anterior* branches are three, viz., the

Superior thyroid,
Lingual,
Labial.

The *posterior* are also three, the

Occipital,
Posterior auris,
Muscular.

The *ascending* are four, the

Temporal,
Internal maxillary,
Transversalis faciei,
Pharyngea ascendens.

Six of these arise from the first stage of the artery, namely, the superior thyroid, lingual, labial, occipital, muscular, and pharyngea ascendens, one only in its second stage, the posterior auris, and the remaining three in its last or third stage.

Arteria thyroidea superior is, in general, the first branch of the external carotid artery, from the internal surface of which it arises, opposite or a little below the cornu of the os hyoides. It first ascends inwards, then curves downwards and forwards, and descends to the inner side of the common carotid artery, accompanied for a short space by the superior laryngeal nerve, which lies posterior to it, towards the thyroid gland, in which it is chiefly lost. The principal branches given off in this course are the following:

The *ramus laryngeus* runs downwards and inwards, accompanied by the superior laryngeal nerve, and enters the larynx, either through an opening in the ala of the thyroid cartilage, or through the thyro-hyoid ligament, to supply its muscles and mucous membrane.

Ramus crico-thyroideus. This branch is more important from its course than from its size; it sometimes arises from the preceding; it runs inwards and enters the larynx, through the crico-thyroid ligament. This branch is much endangered in performing the operation of laryngotomy.

Ramus thyroideus. This is the largest branch, and apparently the continuation of the trunk of the superior thyroid artery. It descends beneath the sterno-thyroid muscle to the thyroid gland, where it is lost, anastomosing with its fellow, and the inferior thyroid artery. From the relations which the superior thyroid artery and its branches bear to the larynx, they are frequently divided in attempts at suicide. Should such be the case, the external surface should be exposed and the bleeding vessels at once be secured with the ligature. Although a fatal hemorrhage is not likely to proceed from any of these branches, yet the bleeding, if allowed to continue, is a source of constant annoyance to the patient, from the blood making its way into the interior of the larynx. Sir E. Home has recommended the tying of the thyroid arteries for the cure of bronchocele. This operation is not now performed.

The labial and lingual arteries are met with in the digastric or supra-hyoid region.

THE DIGASTRIC OR SUPRA-HYOID REGION.

This is a triangular space, situated at the upper and lateral part of the neck, between the digastric muscle below, the inferior maxilla above, and contains the submaxillary and sublingual glands, the external and internal carotid, lingual and labial arteries, the lingual and gustatory nerves, and several muscles. Its apex, inferiorly, is formed by the tendon of the digastric muscle, where it is attached to the cornu of the os hyoides; its base, above, is formed by the body of the inferior maxilla, and a line drawn from it backwards to the mastoid process; it is bounded, in front, by the anterior belly of the digastric, behind by the posterior belly of this muscle. Some anatomists have described this space as being divided into two, an anterior and a posterior, by the stylo-maxillary ligament, the latter containing the parotid gland, &c. This we consider not to be in strict accordance with the anatomy of the parts, as the parotid gland lies almost wholly above the base of the digastric space; we shall therefore consider it as a distinct space, under the name of the parotid region.

On raising the integument, platysma, and cervical fascia, which form the superficial coverings of the digastric space, the submaxillary gland is brought into view. This is the second in size of the salivary glands, the parotid being the largest, and the sublingual the smallest. It lies embedded in the digastric space; bounded above by the inferior maxilla; below by the tendon of the digastric, which it occasionally overlaps a little; behind by the insertion of the internal pterygoid muscle and the stylo-maxillary ligament, the first of which separates it from the parotid gland; and in front by the anterior belly of the digastric muscle. The submaxillary gland rests on the mylo-hyoid and hyo-glossus muscles, and is covered by the skin, platysma, and cervical fascia, which last forms for it a distinct capsule, the outer layer of which is the stronger. A small process of this gland winds round the posterior edge of the mylo-hyoid muscle, accompanies its excretory duct, and lies with it between the muscle and the mucous membrane of the mouth.

The submaxillary gland, like the other salivary glands, is of a pale fawn colour; it is divided into distinct portions by delicate prolongations of cellular tissue, and is traversed by the labial artery, and sometimes the vein, which pass through a deep groove near its posterior extremity.

The structure of this gland consists of a number of acini, united by cellular tissue, from each of which a small primary tube proceeds, and these, uniting together, form the excretory duct. This, the *Whartonian duct*, leaves the gland at its outer end, winding above the mylo-hyoid muscle, and runs forwards and inwards, opens on the frænum linguæ, where its orifice may be distinguished by a small papilla beneath the tongue. This duct receives also a few ducts from the sublingual gland. Its structure is composed of an external fibrous coat, and an internal lining mucous membrane. The fibrous coat is thin and delicate, so that the cavity of the duct is larger in proportion than that of Steno's duct. A second or accessory duct sometimes exists.

The submaxillary gland is supplied with blood from the glandular branches of the labial artery. Its nerves are chiefly derived from the chorda tympani.

The submaxillary gland is sometimes, but not frequently, attacked with inflammation and its consequences. It is liable, in children, to a specific inflammation, known by the name of *Mumps*. Its duct is sometimes obstructed by a calculus, or other cause, when it swells and forms a large tumour named ranula, which projects into the cavity of the mouth, beneath the side of the tongue, interfering with the motions of this organ, and with the acts of respiration and deglutition. The treatment of this disease is simple; it consists in making an opening into the tumour from the mouth, and keeping the aperture patulous by means of a tent or style, as recommended by Dupuytren. A simple puncture will sometimes be sufficient for its removal. The submaxillary gland is also sometimes the seat of malignant disease; if so, its extirpation should be had recourse to, if not contra-indicated. Some have denied that it can be accomplished. We see nothing to prevent it.

The submaxillary gland is traversed by

The *Arteria labialis*, vel *facialis*, vel *maxillaris* *externa.* This vessel arises from the external carotid artery, immediately after, or along with, the lingual artery. From its origin it ascends inwards, and then enters the inferior edge of the submaxillary gland, and nearer its posterior extremity, runs through the gland in a tortuous manner, and escapes from its superior edge; it now descends, and turning again upwards and outwards, round the side of the jaw, close to the anterior edge of the masseter muscle; it then runs upwards and inwards to the angle of the mouth, whence it ascends almost vertically along the side of the nose to the inner canthus of the eye, where it terminates. The labial artery, at its origin, is concealed by the digastric and stylo-hyoid muscles; immediately above this it is embedded in the gland; as it crosses the inferior maxilla, it is superficial, and may be felt pulsating during life, being covered only by the skin, and a few fibres of the platysma and triangularis oris muscles. As it ascends on the face it is remarkably tortuous, and is partly concealed by the adipose tissue of the cheek and a few fibres of the zygomatic and levator labii superioris muscles. The branches of the labial artery are divided into the cervical and the facial; the former are four, the latter are six in number. The cervical branches are as follows:

1. *Arteria palatina inferior* ascends inwards and backwards, between the stylo-glossus and stylo-pharyngeus muscles, sends off several branches to the mucous membrane of the pharynx, velum, and tonsil, and terminates by anastomosing with the superior palatine artery from the internal maxillary.

2. *Arteria tonsillaris* ascends between the stylo-glossus and internal pterygoid muscles, to which it sends branches, and terminates in the tonsil, where it anastomoses with the preceding and with branches from the internal maxillary.

3. *Arteriæ glandulares.* Irregular in number; they are distributed to the submaxillary gland.

4. *Arteria submentalis,* is a branch of considerable size; it runs along the inner surface of the inferior maxilla, towards the chin, and close to the origin of the mylo-hyoid muscle; it sends off branches to all the surrounding structures, and terminates anteriorly in a number of branches, some of which anastomose with the corresponding branches from the opposite side, whilst others wind round the chin to anastomose with the terminating branches of the inferior dental and inferior labial arteries.

The facial branches of the labial artery are the following:

1. *Arteria labialis inferior* runs inwards to the integuments and muscles of the lower lip, where it anastomoses with the branches of the preceding, the inferior dental, and the artery of the opposite side.

2. *Arteria coronaria inferior* ascends inwards beneath the fibres of the depressor anguli oris, gains the lower lip, near the free margin of which it runs close to the mucous membrane; it supplies the lower lip, anastomosing with the artery of the opposite side, with the superior coronary, the inferior labial, and the inferior dental arteries.

3. *Arteriæ massetericæ* are a few irregular branches which pass outwards to the masseter and buccinator muscles, and anastomose with the branches of the transversalis faciei artery.

4. *Arteria coronaria superior* runs inwards to the upper lip, where it lies near its free border and close to the mucous membrane. It supplies the upper lip, sending a few branches upwards to the schneiderian membrane of the nose. It anastomoses with its fellow of the opposite side and with the inferior coronary and nasal arteries.

In operating on the upper lip for hare-lip, and on the lower for the removal of cancerous growths, the coronary arteries are wounded. The hemorrhage, during the operation, may be restrained by compressing the lip between the fingers until the operation is completed, when, the edges of the wound being brought together, the bleeding will in general cease. In passing the needles through the lip, to retain the cut surfaces in apposition, they should be passed deep through its substance, close to the mucous membrane. If passed more superficially, the posterior part of the wound will gape, and the coronary arteries bleed into the mouth. The first needle should always be passed close to the free border of the lip, in order that no irregularity be left in it. As the lower lip contains a large number of glands, it is more frequently attacked with cancer than the upper. Blows on the mouth sometimes divide the lips on the inner surface, by pressure against the teeth; here a suture should be inserted, and thus the wound be closed internally.

5. *Arteria lateralis nasi* is a small branch distributed to the side of the nose.

6. *Arteria angularis* is the terminating branch of the labial artery; it ascends between the heads of the levator labii superioris alæque

nasi, to the inner canthus of the eye, sends branches to the lids and caruncula lacrymalis, which anastomose with branches from the infraorbital and ophthalmic arteries.

The *angular vein* proceeds from the terminating branches of the angular artery; it descends close to the artery to form the labial vein. This vein takes a nearly vertical course downwards, along the side of the cheek, crosses Steno's duct, where it is at some distance from the artery, descends over the side of the inferior maxilla, and terminates in the internal jugular vein in the anterior superior triangle of the neck. It frequently sends off a branch to join the external jugular vein.

The angular vessels, and more particularly the vein, are endangered in performing the operation for the cure of fistula lacrymalis. The incision should be made on the outer side of these vessels.

The trunk of the labial artery, whilst in the neck, is engaged in the operations of extirpating the submaxillary gland, or in removing the lower jaw; when divided it should be at once secured. In the face it is much exposed to wounds, as also the several operations performed in this region. When wounded, the vessel may be compressed by the finger of an assistant, where it crosses the inferior maxilla, until the cut artery is secured. Small tourniquets have been invented for the purpose, but are unnecessary.

In no part of the body, perhaps, does a more free anastomosis of the smaller arterial branches exist than between the vessels of the face. This has an important influence in restoring the circulation when the carotid artery has been tied. It also affects materially the treatment of aneurism by anastomosis, in which we consequently seldom succeed by tying the artery leading to the tumour.

On raising the submaxillary gland, the mylo-hyoid muscle is exposed, and behind it a small portion of the hyo-glossus. The *mylo-hyoid* muscle, extending from the mylo-hyoidean ridge of the inferior maxilla to the os hyoides, is continuous on the mesial line with its fellow of the opposite side, forming a species of diaphragm, which is of much use in the act of sucking. On raising it, the *hyo-glossus* is exposed, stretching from the side of he tongue to the os-hyoides. On the cutaneous surface of this muscle, the Whartonian duct, the gustatory and lingual nerves, and lingual vein are seen. The gustatory nerve first lies above the duct, then arches beneath it, and finally ascends again above it, to be distributed to the papillæ on the side and tip of the tongue. It anastomoses freely with the lingual nerve, which lies near the os hyoides on the hyo-glossus muscle. The lingual artery passes along the deep surface of the hyo-glossus muscle, or between its fibres, which thus separate it from the lingual nerve.

On the mesial line the genio-hyoid muscle is seen running parallel to its fellow, from the chin to the os hyoides. By a little further dissection, the *lingualis* and *genio-hyo-glossi* muscles will be exposed, the latter on the mesial line, the former to its outer side, and separated from it by the ranine artery; as also the three styloid muscles, the *stylo-hyoid* most superficial, the *stylo-glossus* next, and the *stylo-pharyngeus* deepest. Beneath the anterior and lateral part of the tongue, and covered by the mucous membrane of the mouth, to which it adheres closely, is the *sublingual gland*, the smallest of the salivary glands. This resembles the other salivary glands in appearance and structure. It is somewhat oblong in shape, and is bounded above by the mucous membrane, internally by the genio-hyo-glossus muscle, and inferiorly by the mylo-hyoid. It is often connected by its posterior extremity with the prolonged portion of the submaxillary gland; indeed all the salivary glands are frequently joined together by distinct processes. The sublingual gland gives off several ducts, some of which perforate the mucous membrane of the mouth, beneath the side of the tongue, whilst others join the Whartonian duct.

Arteria lingualis arises from the external carotid, in general between the superior thyroid and labial arteries. From its origin the lingual artery curves forwards and inwards towards the os-hyoides, forming an arch convex upwards, and separated from the corresponding arch of the superior thyroid artery by the cornu of the os hyoides. It passes immediately above the os hyoides, internal to or through the fibres of the hyo-glossus muscle, which here separates it from the lingual nerve placed on the cutaneous surface of this muscle. The artery then ascends towards the base of the tongue, from which it proceeds horizontally forwards, along its under surface, to its anterior extremity, where it terminates. Before it reaches the hyo-glossus muscle, the lingual artery is covered externally by the integuments, platysma, and fascia, and near the cornu of the os hyoides by the tendon of the digastricus; it rests on the superior laryngeal nerve, and some cellular substance, and near the os hyoides on the middle constrictor of the pharynx; the lingual nerve lies superficial and a little superior to it. Beneath the hyo-glossus it is covered, in addition to the fibres of this muscle, by the mylo-hyoid, and rests on a few fibres of the genio-hyo-glossus. Beyond the hyo-glossus, it is again joined by the lingual nerve, which terminates with it in the tongue.

The principal branches of the lingual artery are three in number.

Arteria dorsalis linguæ arises beneath the hyo-glossus muscle, runs outwards to the side of the tongue, winds round it and gains its dorsal surface, where it terminates, anastomosing with its fellow of the opposite side. In its course this artery sends branches to the tonsil, velum, and fauces. Its place is often supplied by a number of branches.

At the anterior margin of the hyo-glossus, the lingual artery divides into its two terminating branches, the sublingual and the ranine.

Arteria sublingualis runs forwards and outwards to the sublingual gland. It sends a few branches to the surrounding muscles and mucous membrane.

Arteria ranina is apparently the continuation of the lingual artery. It runs along the under surface of the tongue from the base to its apex, between the lingualis and genio-hyo-glossus muscles, covered by the mucous membrane, its vein, and a branch of the lingual nerve. Besides sending a few branches to the muscles and mucous membrane of the tongue, it supplies the substance of this organ, in which and near its tip it anastomoses with the artery of the opposite side. This anastomosis is not free, as each side of the tongue may be filled with a different coloured injection.

In all operations near to the under surface of the tongue, such as dividing the frænum in children, opening abscesses in this region, &c., the course of the ranine vessels should be attended to. In dividing the frænum linguæ, the point of the scissors should be directed downwards and backwards; if turned upwards, the ranine vessels, and more particularly the vein, will be endangered. Hemorrhage from the tongue frequently occurs in consequence of wounds or deep ulcers. In cases of wounds, it is difficult to take up the divided ends of the vessel, in consequence of its retracting into the substance of the tongue. The bleeding may often be checked by bringing the internal surfaces together by means of a suture. If this and other local applications fail, the lingual artery may be tied by making a vertical incision over the digastric tendon; this being exposed, the artery will be brought into view, either above or below the tendon, as may be desired. Mr. Harrison, in his work on the arteries, recommends a transverse incision for this purpose through the integuments and fascia from the os hyoides to the mastoid muscle. When profuse bleeding takes place from a deep ulcer, and local measures have been found ineffectual to repress it, the lingual artery should be tied near to the digastric tendon. Some recommend in both these cases the tying of the external carotid artery, and this indeed is the operation which will be found most easy of performance, and perhaps more effectual from its interrupting the flow of blood by means of the anastomosis between the lingual and labial arteries.

The posterior branches of the external carotid are the following:

1. *Arteria muscularis* vel *sterno-mastoidea* is an irregular branch, which frequently arises from the superior thyroid or the occipital. It runs downwards and outwards to the sterno-mastoid muscle, accompanied by the spinal accessory nerve. It supplies this muscle, the scaleni, and rectus capitis anticus major, anastomosing with branches from the occipital, superior thyroid, and transversalis colli arteries.

2. *Arteria posterior auris* arises from the second stage of the external carotid artery. It runs upwards and backwards along the inferior margin of, and partly embedded in, the parotid gland, towards the mastoid process, passing between the portio dura and spinal accessory nerve; it then ascends between this and the ear, and divides into two branches, an anterior and a posterior; the anterior branch is lost in the integuments and cartilage of the ear, principally on its posterior surface; the posterior branch ascends on the lateral surface of the cranium to the integument and temporal muscle, where it anastomoses with the branches of the temporal and occipital arteries. The posterior trunk sends off a small branch which enters the stylo-mastoid foramen, to supply the temporal bone and internal ear.

In cutting down on the portio dura nerve for the relief of tic doloureux, the posterior auris artery is necessarily divided.

3. *Arteria occipitalis* arises from the outer surface of the external carotid, immediately below the digastric muscle. Shortly after its origin it hooks round the lingual nerve, which at the same time gives off its descendens noni branch; the occipital then crosses the internal carotid artery, the internal jugular vein, the pneumo-gastric and spinal accessory nerves, ascends under cover of, and conducted by the posterior belly of the digastric muscle towards the base of the cranium; it here runs in a groove in the temporal bone on the inner side of the mastoid process, passes above the transverse process of the

atlas, resting on the rectus capitis lateralis muscle; it then passes backwards, becomes superficial close to the outer edge of the trapezius muscle, and ascends in the scalp on the posterior surface of the cranium, where it terminates in numerous branches, which supply the region of the scalp and anastomose with the artery of the opposite side, the posterior aural and temporal branches. It is here accompanied by branches of the great occipital nerve. The occipital artery lies deep, except near to its termination; it is at first concealed by the sterno-mastoid, stylo-hyoid, and digastric muscles, and the lower margin of the parotid gland; above and behind this, it is covered by the trachelo-mastoideus, splenius capitis, and sometimes by the complexus; it here crosses the occipital attachments of the posterior recti and superior oblique muscles. In the scalp it is superficial, and may be felt during life.

As the occipital artery crosses the internal jugular vein, it sends off a posterior meningeal artery, which ascends along the internal jugular vein, and enters the foramen lacerum posterius to supply the dura mater. Between this and its course in the scalp it sends off numerous branches to the surrounding muscles; some of these anastomose with branches of the vertebral artery, others descend amongst the muscles of the neck, and anastomose with branches of the transversalis colli, transversalis humeri, and cervicalis profunda arteries.

From the superficial course of the occipital artery in the scalp, it is here exposed to injury. If wounded, serious hemorrhage is the result. The artery should be secured by ligature, if pressure be not found sufficient.

The ascending branches of the external carotid are the following:

Arteria pharyngea ascendens. This artery, from the depth at which it lies, will be best dissected after the examination of the parotid region. It is a small branch, and arises near to the origin of the external carotid; from this it ascends towards the base of the cranium, between the pharynx and internal carotid, and close to the vertebral column, and terminates in a few branches, which ascend through the foramen lacerum medium to the dura mater.

In this course the artery sends off several branches to the muscles and mucous membrane of the pharynx, the tonsil and velum, in which they anastomose with the arteries distributed to those parts from the labial and internal maxillary.

The three remaining branches of the external carotid are given off in the parotid gland; we shall therefore now consider the parotid region.

PAROTID REGION.

This is a quadrilateral space, situated between the ear and mastoid process, bounded in front by the ramus of the lower jaw and masseter muscle, above by the zygoma, and below by the stylo-maxillary ligament and a line drawn from the angle of the jaw to the mastoid process, which separate it from the digastric space, properly so called. In it are contained the parotid gland, and embedded in its substance the portio dura, the external jugular vein, the external carotid artery, and the origins of the temporal, internal, maxillary, and transversalis faciei arteries; and more deeply seated the internal carotid artery, the internal jugular vein, the eighth, ninth, and sympathetic nerves, with some branches of the inferior maxillary nerve. The parotid gland lodged in this space is covered by the skin and a few fibres of the platysma, immediately beneath which lies the superficialis colli nerve, a branch of the cervical plexus, which ascends to the integuments of the temporal region. One or two lymphatic glands are occasionally met with here, immediately in front of the external ear. These sometimes become diseased and enlarged, and by pressing on the parotid gland, seem to occupy its situation. Such affections have been mistaken for disease of the parotid gland itself.

Underneath these, the parotid gland is covered by a dense layer of the cervical fascia, which gives to the surface of the gland a flattened or slightly convex shape, and ascends on its cutaneous surface to be attached to the zygoma; posteriorly, this layer of fascia is attached to the external meatus auditorius, and is lost on the mastoid muscle. The cervical fascia not only covers the gland on its cutaneous surface, but sends processes into its interior, which separates it into distinct portions, and gives to it the granulated appearance for which it is so remarkable. The deep surface of the gland is not covered by the fascia, but sinks irregularly into the several intervals met with at the base of the skull, between the nerves, vessels, &c. Thus, prolongations of the gland are met with, surrounding the styloid process, between the internal lateral ligament and the lower jaw, in the posterior part of the glenoid cavity, and between the pterygoid muscles; consequently, the parotid gland, from the great depth to which it extends, has most important relations, namely, the internal carotid artery, the internal jugular vein, the eighth and ninth nerves, and the third division of the fifth nerve, relations which must render the removal of this gland one of the most formidable operations in surgery.

The great strength of the cervical fascia covering the outer surface of the parotid gland, has much influence on its diseases. When the gland becomes attacked with acute inflammation (*cynanche parotidea*), the distension of the gland is resisted by the fascia; this adds much to the sufferings of the patient, from the gland being forced inwards so as to compress the numerous nerves connected with it. The motions of the lower jaw and tongue are also interfered with from the same cause, so that the acts of mastication and deglutition are with difficulty performed. If the inflammation be not controlled by appropriate treatment, matter forms, which is bound down by the fascia, and is thus prevented from coming to the surface; it spreads beneath the fascia, and may undermine this to a considerable extent. More frequently the matter bursts through the deficiency in the anterior part of the meatus auditorius externus, and is thus discharged by the external ear. It is the duty of the surgeon to anticipate the painful process and relieve the sufferings of his patient by an early incision through the fascia. In doing so, it has been recommended to cut down, first on the fascia, to make a small puncture into it, and then dilate this on the director. This precaution is advised on account of the relation of the external carotid artery; we question if it be necessary, as the matter, as well as a portion of the gland, separates the vessel from the fascia.

On removing the cervical fascia, the structure of the parotid gland is exhibited. It is composed, like most conglomerate glands, of a number of granules or *acini*, separated by prolongations of the cervical fascia, so as to render them distinct from each other, and give to the gland an irregular granulated appearance. These acini are composed each of a small artery, vein, nerve, absorbent, and deferent duct; and these ducts collect the salivary fluid, and convey it to the common duct, named *Stenonian* or the parotid duct. This duct then arising by a number of smaller ducts or radicles, emerges from the anterior and rather upper margin of the gland, passes forwards across the masseter muscle, about an inch below the zygoma, and in a line drawn from the lobe of the ear, to midway between the angle of the mouth and the root of the nose, accompanied by the transversalis faciei artery and nerves, both which lie above it. Having arrived at the anterior edge of the masseter muscle, the mucous or lining membrane of the duct dips inwards, perforates the buccinator muscle, and open by a contracted orifice into the mouth, on the inner surface of the cheek, opposite the second molar tooth of the upper jaw, and about half an inch beneath the reflexion of the mucous membrane of the cheek on the gums The fibrous coat of the duct, on the contrary, does not perforate the buccinator muscle, but expands and is lost on its outer surface. Steno's duct is composed of two coats, an external *fibrous* and anterior internal lining *mucous* membrane. The fibrous coat is remarkably strong, and forms the greater portion of the caliber of the duct, its cavity being comparatively small. The lining mucous membrane is continuous with that of the mouth. Between the zygoma and Steno's duct, a small portion of the gland, somewhat detached from the rest, lies on the masseter muscle. It is called the *socia parotidis.* A small duct proceeds from it, which joins the parotid duct, or opens by a distinct aperture into the mouth.

Steno's duct is sometimes cut into by accident, or in performing operations on the face ; wounds of it are exceedingly difficult of cure, as the saliva flows through the opening, and thus forms a fistula, from which the saliva escapes to the detriment of the digestive function. If the wound should not have been united by the first intention, the introduction of a tent into the mouth, so as to conduct the fluid in that direction, until the external wound shall have closed, affords the most probable chance of success.

The parotid gland is supplied with blood by branches from the external carotid and temporal arteries. Its veins return the blood to the external jugular. It is liable to inflammation and suppuration, as also to the more malignant diseases. Its removal for the latter affection has been accomplished in two or three instances.

On cutting cautiously through the substance of this gland, or rather by scraping through it from behind forwards, the portio dura nerve is first brought into view. This nerve escapes from the stylo-mastoid foramen, gives off a few branches to the stylo-hyoid and digastric muscles, and immediately after enters the posterior and deep surface of the gland, which it traverses in a direction forwards and outwards, and escapes from its anterior margin on the masseter muscle, and is lost on the integuments and muscles on the side of the temple, face, and neck. In the substance of the parotid gland, the portio dura presents a remarkable appearance, the *pes anserinus*, formed by its division into two trunks, the temporo-facial, and the cervico-facial, and the subdivision of these into numerous branches, some of which ascend, others pass transversely, whilst others descend. The pes anserinus lies superficial to the external jugular vein and external carotid artery, and is separated from them by a small portion of the gland.

By removing a little more of the gland, the external jugular vein and the external carotid artery will be exposed, the former lying superficial to, but in close contact with the latter.

The external jugular vein is formed in the substance of the parotid gland, by the junction of the internal maxillary and temporal veins, from thence it descends in the neck, and terminates in the subclavian vein.

The external carotid artery lies in the parotid gland, beneath the portio dura and external jugular vein ; it here gives off its last branches, viz. the *transversalis faciei*, the *temporal* and *internal maxillary* arteries : the last two are more particularly its terminating branches, and arise opposite a point nearly midway between the zygoma and the angle of the lower jaw, but a little nearer the former.

Arteria transversalis faciei arises a little above the angle of the jaw, runs upwards and forwards through the gland, escapes from its anterior margin, crosses the masseter muscle, parallel to and above the parotid duct, accompanied by filaments of the portio dura and partly concealed by the socia parotidis. At the anterior edge of the masseter muscle, the artery terminates in numerous branches, which are lost in the integuments and muscles of the side of the face, anastomosing with the branches of the labial, temporal, and infraorbital arteries. The transversalis faciei artery is sometimes wounded in blows on the cheek ; it should be secured with a ligature.

Arteria temporalis superficialis is smaller than the internal maxillary, but runs more in the direction of the primitive trunk. From its origin, the temporal artery ascends through the parotid gland in front of the meatus auditorius, escapes from its upper margin, crosses the zygoma near its root and directly in front of the tragus of the external ear, ascends slightly forwards on the temporal aponeurosis, and about an inch or an inch and a half above the zygoma, terminates by dividing into two branches, the anterior and posterior temporal arteries. The temporal artery first lies deep in the parotid gland; as it crosses the zygoma it is superficial, and may be felt or compressed here during life; above this it is crossed by the attrahens aurem muscle, and is covered by a prolongation of the cervical fascia; still higher up it is covered only by the integuments.

In the parotid gland the temporal artery gives off a few branches to the gland, the external ear, and articulation of the lower jaw. Immediately after crossing the zygoma it sends off the following:

Ramus temporalis medius arises from the deep surface of the temporal artery, perforates the temporal aponeurosis, and supplies the temporal muscle, anastomosing with the branches of the deep temporal arteries.

Ramus temporalis posterior passes backwards and upwards to supply the scalp and anastomose with the branches of the posterior aural and occipital arteries and those of the opposite side.

Ramus temporalis anterior runs upwards and forwards, supplies the integuments and muscles of the forehead, and anastomoses with the frontal branches of the opthalmic artery.

The anterior temporal artery is that usually selected for the performance of arteriotomy, when the operation is required, as in cases of violent inflammation of the brain and membranes, deep-seated opthalmia, apoplexy, &c. The patient being placed in the sitting posture, with his side turned towards the light, the surgeon feels for the pulsation of the vessel. Having ascertained its precise situation, he fixes it firmly between the first and second fingers of the left hand, held about half an inch apart; in the interval he makes an incision over the artery with a lancet or scalpel. The vessel being exposed, it may be opened obliquely. If cut across, the divided ends of the vessel will retract, and a sufficient quantity of blood cannot be drawn. When the blood flows slowly a warm sponge should be applied to the part, or the course of the artery filliped with the finger. As soon as a sufficient quantity of blood has been taken, the edges of the wound are to be brought together, and retained in apposition with a strap of adhesive plaster; over this a compress is to be placed, and the whole secured with a bandage brought round the forehead and under the chin. It has been recommended to cut the artery across, before closing the wound; it is in general unnecessary to do so, unless the branch divided be larger than usual.

Secondary hemorrhage not unfrequently follows the operation. Should it prove troublesome, the end of the vessel may be secured with the ligature. As it is, however, difficult to tie arteries in the scalp, a better method is the introduction of a dossil of lint, moistened with spirits of turpentine, into the wound, and placing over it a compress and bandage as before; this method will never fail if properly executed. The cutting across the artery (if not previously done) may also be had recourse to.

The operation of arteriotomy should never be resorted to when other means may accomplish the desired ends, as, independently of secondary hemorrhage, many other after-consequences result, which are sources of much distress to the patient. The presence of the bandage is often found exceedingly unpleasant. Besides, erysipelas occasionally supervenes, the wound sloughs, inflammation of the temporal aponeurosis takes place, and may be followed by the formation of matter beneath the fascia; sometimes one or more of the numerous nervous filaments which accompany the artery are injured, giving rise to severe neuralgic affections.

The artery should never be opened close to the zygoma, as it may shrink beneath this into the substance of the parotid gland, and thus pour out blood in large quantities before the hemorrhage can be restrained.

Arteria maxillaris interna, larger than the temporal, passes off nearly at a right angle from the bifurcation of the external carotid artery. It soon passes to the inner side of the neck of the lower jaw, and, pursuing a tortuous course forwards and inwards, terminates in the pterygo-maxillary fossa by dividing into the infraorbital, descending palatine, and nasal arteries. The internal maxillary artery, although not of great length, is usually divided, in order to facilitate its description, into three stages. In the first stage it descends inwards and lies between the ramus of the lower jaw and the internal lateral ligament. In the second stage it ascends forwards and inwards, passing through a triangular space bounded above by the external pterygoid muscle, below by the internal pterygoid, its apex being at the origin of these muscles, its base directed outwards at the ramus of the jaw, whence it winds over the external pterygoid muscle, lies between it and the temporal muscle, and arrives at the back part of the orbit; it then descends and completes its third stage in the pterygo-maxillary fossa.

The branches of the internal maxillary artery are ten in number; viz.,

Arteria meningea media,
Maxillaris inferior,
Pterygoideæ,
Temporales profundæ,
Massetericæ,
Buccales,
Maxillaris superior,
Infraorbitalis,
Palatina descendens,
Nasalis.

In the first stage it gives off the two following:

1. *Arteria meningea media* is the largest branch of the internal maxillary, from the superior part of which it arises. It thence ascends towards the cranium between the internal lateral ligament and the tensor palati, giving off branches to the surrounding structures, and passing through the spinous foramen of the sphenoid bone, enters the cavity of the cranium: it here lies between the bone and dura mater, in a groove in the former, sometimes for a part of its course is a complete bony canal and closely connected to the latter. It first crosses the squamous portion of the temporal bone, then the anterior inferior angle of the parietal, and thence ascends, parallel and a little posterior to the coronal suture, to the vertex, where it is lost in numerous branches, which are variously distributed to the bones. In this course the middle meningeal artery gives off several branches, the course of which may be recognized by the grooves in the several bones.

The branches of the meningeal arteries are principally lost in the supply of the bones of the cranium. The dura mater thus acts as an internal periosteum to the skull; indeed it would appear that it is more essential to its support than the external periosteum, from its great degree of vascularity, and from its separation from the bones, whether produced by external violence or other causes, being more assuredly followed by necrosis or death of the bone. This circumstance, as also the free anastomosis between the vessels of the dura mater and the external periosteum, is of much importance in practice, as being the cause of that direct sympathy which exists between the external coverings of the skull and the parts contained within. Whenever, therefore, the coverings are injured or diseased, too much caution cannot be observed by him in forming a prognosis, or in combating any symptoms that may lead him to suspect that the internal membranes are likely to participate in the diseased action.

From the size of the middle meningeal artery, injuries to it or to the bones of the cranium with which it is connected, are of peculiar interest. Should this vessel be ruptured, a large quantity of blood may be effused between the bone and dura mater, and thus give rise to dangerous symptoms of compression of the brain. Here the surgeon will find it necessary to trephine over the course of the vessel, and thus give exit to the effused blood. Ancient surgeons were much in dread of operating on any part of the cranium beneath which an artery, or indeed a vein, lay, from an erroneous impression that the hemorrhage could not be restrained. So far from this being the case, the bleeding is found to be arrested more easily than that from other arteries, a circumstance imputed to the less thickness of the middle coat of the meningeal arteries; but is more probably owing to the laceration of the vessel caused by the forcible removal of a part of the bone by the trephine.

The trunk of the middle meningeal artery is easily exposed, as it crosses the anterior inferior angle of the parietal bone. To discover this, draw a horizontal line backwards from a little above the external angular process of the frontal bone, meet this with a vertical line raised from the centre or most prominent part of the zygoma, the point where the two lines meet is directly over the anterior inferior angle of the parietal bone. Make an incision in the course of the fibres of the temporal muscle down to the bone, and apply the trephine. If the artery should continue to bleed after the bone has been removed, the pressure of a small dossil of lint on its orifice will command the hemorrhage.

2. *Arteria dentalis* vel *maxillaris inferior* proceeds from the lower surface of the internal maxillary artery, nearly opposite to the preceding. It thence descends, accompanied by the inferior dental nerve, to the dental foramen, between the lower jaw and the internal lateral ligament, which last separates it from the gustatory nerve. It now enters the inferior dental foramen, traverses the canal in the inferior maxilla, below the fangs of the teeth, and near its anterior extremity divides into two branches: one of which continues its course onwards in the canal beneath the incisor teeth; the other, the mental artery, accompanied by a branch of the inferior dental nerve, escapes through the mental foramen, and is lost in the muscles and integuments of the lower lip, in which it anastomoses with the inferior labial and coronary arteries.

Before entering the dental foramen, the inferior dental artery gives off a few branches: some of these proceed to the pterygoid muscles and mucous membrane of the pharynx, one runs in the mylo-hyoid groove of the lower jaw, accompanied by the nerve of the same name, to the mylo-hyoid muscle. In the canal, branches ascend from it which, perforating the roots of the teeth, are lost in their supply.

In removing one or more of the teeth of the lower jaw, the inferior dental artery, or some of its branches, may be injured; and should the hemorrhage prove troublesome, a dossil of lint, or piece of sponge, or even wood of a conical form, should be introduced into the wound, or (which is still more effectual) the tooth may be replaced, and allowed to remain for some time.

In the second stage the internal maxillary artery gives off muscular branches and the superior dental or maxillary artery: they are as follows:

3. *Arteriæ pterygoideæ,* irregular in number, are distributed to the pterygoid muscles.

4. *Arteriæ temporales profundæ,* two in number, enter the temporal fossa, in which they ascend, close to the bone, under cover of the temporal muscle, one near the root of the zygoma, the other near the malar bone. They supply the temporal muscle and anastomose with the middle temporal arteries.

5. *Arteriæ massetericæ,* two or three in number, pass outward through the sigmoid notch of the lower jaw to supply the masseter muscle.

6. *Arteriæ buccales* supply the buccinator muscle. All these arteries are accompanied by branches from the inferior maxillary nerve.

7. *Arteria dentalis* vel *maxillaris superior* arises near the tuberosity of the superior maxilla, runs forwards along the outer surface of the bone, above the alveoli, and close to the origin of the buccinator muscle. Its branches supply the bone, the antrum, and the roots of the teeth, anastomosing with the branches of the infraorbital artery.

In its third stage, or whilst in the pterygo-maxillary fossa, the internal maxillary artery gives off the following:

8. *Arteria infraorbitalis,* the largest of the terminating branches, runs upwards and forwards, traverses the infraorbital canal from behind forwards, accompanied by the infraorbital nerve, sends branches upwards to the orbit and downwards to the antrum, and escapes through the infraorbital foramen upon the face, between the levator labii superioris alæque nasi and levator anguli oris muscles: it here spreads out into several branches, which anastomose with the branches of the labial and transversalis faciei arteries.

9. *Arteria palatina descendens* descends in the posterior palatine canal and divides into two branches, the smaller of which passes through a foramen in the pterygoid process of the palate bone, and is lost in the velum; the larger descends in the canal to the *palate,* accompanied by nerves from Meckel's ganglion, turns forward, runs close to the inner surface of the alveolar processes of the superior maxilla, supplies the hard palate, and sends a branch through the foramen incisivum to the nose.

10. *Arteria nasalis* passes through the spheno-palatine foramen into the nasal cavity, opposite the posterior extremity of the superior meatus, and is lost in the schneiderian membrane and adjoining mucous membrane of the pharnyx.

ARTERIA CAROTIS INTERNA VEL PROFUNDA.

This vessel, so named from supplying the interior of the cranium, lies posterior and external to the external carotid at its origin, and is much larger in the fœtus and the young subject, but in the adult, the two vessels are nearly of equal size. From the bifurcation of the common carotid, the internal carotid ascends in front of the transverse processes of the three superior cervical vertebræ to the base of the cranium, where it enters the foramen caroticum, then traverses the carotic canal, runs above the foramen lacerum medium, and ascending by the side of the sella turcica, and passing through the cavernous sinus, it arrives opposite the inner extremity of the fissure of Sylvius, and terminates by dividing into the anterior and middle cerebral and posterior communicating arteries.

In the neck the internal carotid is very tortuous, particularly at the early periods of life. It first bends outwards, then ascends forwards and inwards, and near the temporal bone forms one or more curves, irregular in shape and number. In this course it is covered by the external carotid, from which it is separated by the styloid process, the stylo-glossus, and stylo-pharyngeus muscles, the glosso-pharyngeal nerve, and a portion of the parotid gland. It is still further covered by the digastric muscle, the lingual and facial nerves. The internal carotid artery rests first on the rectus capitis anticus major muscle, then on the par vagum and the superior cervical ganglion of the sympathetic. The internal jugular vein, near the base of the skull, lies almost directly behind it, but as the vein descends it also gets external to it. The lingual nerve, as it escapes from the anterior condyloid foramen, lies posterior and internal to the internal carotid artery, but soon, passing between it and the internal jugular vein, or between the branches of the latter, gets external to it, and finally crosses both carotid arteries a short distance below the digastric muscle. The spinal accessory nerve, as it descends, passes behind the internal jugular vein, and thus has little or no relation to the internal carotid artery.

To the inner side of the internal carotid artery lies the pharynx, separated from it by a small interval inferiorly, but more closely connected above. The tonsil is also internal and somewhat anterior to it.

In inflammation of these parts, but more particularly of the tonsils, this relation to the internal carotid artery is of much importance. Should abscess form in the gland, the matter should be discharged by directing the instrument backwards; on no account should it be turned outwards, as the artery is thereby much endangered. It is true that, in the healthy state, the tonsil is not in close contact with the internal carotid artery, but is so in the inflamed state; for when the gland inflames it enlarges inwards towards the fauces and opposite tonsil, and also presses outwards so as almost to touch the artery.

Whilst passing through the petrous bone, the internal carotid artery takes a curved course also; it first ascends, then passes forwards and inwards, and then ascends again, passing at the same time a little inwards; in this course it forms a curve resembling an italic *S*. As it enters the foramen caroticum it lies directly behind the Eustachian tube, and then lies immediately in front of the cavity of the tympanum, being separated from it by a thin plate of bone, not unfrequently absorbed, particularly in advanced life; as the artery runs forward it lies beneath and to the outer side of the cochlea, and below the Eustachian tube; it soon after gets above this, and, at the foramen lacerum medium, is only separated from it by a fibro-cartilaginous substance, which assists in closing up the opening. As the internal carotid artery passes through the carotic canal, it is accompanied by numerous filaments from the superior cervical ganglion of the sympathetic, which ascend along with it to the cavity of the cranium, and terminate by sending off minor plexuses to accompany the branches of the artery and by anastomosing with the cerebral nerves on the side of the cavernous sinus.

The internal carotid is but little exposed to accidents, and still less to the knife of the surgeon. It has been occasionally divided in deep injuries of the neck, or by foreign bodies being driven along the cavity of the mouth, through the walls of the pharynx. Several instances have occurred where tobacco-pipes have been forced in this direction so as to wound the internal carotid artery. When the hemorrhage is not immediately fatal, the common carotid artery should be secured. It is possible that this will not be sufficient to restrain the bleeding from the upper end of the divided vessels. If such be the case, and pressure be ineffectual, the other common carotid should be tied.

From the relation of the internal carotid to the organ of hearing, and to the different nerves distributed to the eye and orbit, organic or functional disease of it has much influence on both the senses of hearing and vision, and gives rise to symptoms too often considered as the result of diseases of the ear or eye; thus, tinnitus aurium, twitchings of the muscles of the eyelid, amaurosis, &c. are frequently induced by the morbid condition of this vessel. As the internal carotid winds through the petrous bone, it is implicated in fractures affecting the base of the skull, and may be ruptured, giving rise to hemorrhage from the external ear. Such cases are beyond the power of art.

In its cervical and temporal stages the internal carotid artery gives off no branch of importance; but sometimes the pharyngea ascendens arises from it in the neck: as it escapes from the cavernous sinus it gives off the following:

1. *Arteria ophthalmica* passes forwards, enters the orbit along with the optic nerve, contained in a sheath of the dura mater; it first lies beneath the nerve, but, as it passes forwards, winds round it, first crossing its outer side, and then rising above it, and terminates at the inner side of the orbit, and near its anterior part, by dividing into numerous small branches.

The branches given off by the ophthalmic artery are as follows:

1. *Arteria lacrymalis* passes forwards to the lacrymal gland, in which it is chiefly lost, sending a few branches to the lids, and one or two which perforate the malar bone and anastomose with the deep temporal arteries.

2. *Arteria centralis retinæ,* small in size, arises near the optic foramen, penetrates the optic nerve, and runs forward in its centre to the interior of the eye; on arriving at the posterior part of the vitreous humour, it sends off numerous branches, which form or supply the inner layer of the retina. A small branch perforates the hyaloid membrane, passes forwards through the vitreous humour as far as the capsule of the lens. When the optic nerve is cut across, this artery forms a dark spot in the centre, which was formerly called the *porus opticus.*

3. *Arteria supraorbitalis* arises as the ophthalmic artery crosses the optic nerve, and is of considerable size; it ascends forwards, runs between the periosteum and levator palpebræ superioris muscle, accompanied by the frontal nerve, passes out through the superciliary notch, ascends on the forehead as high as the vertex, anastomosing with the branches of the facial and temporal arteries. Besides its terminating branches, the supraorbital artery sends off several branches to the parts in its immediate neighbourhood; none of them are of importance.

4. *Arteriæ ciliares* consist of three sets, the short, long, and anterior. The short, irregular as to origin, are about eight or

ten in number; they pass along with the optic nerve, some above others below it, accompanied by the ciliary nerves; by dividing, they increase in number as they approach the globe of the eye, and perforate the posterior part of the sclerotic coat at about two lines distance from the entrance of the optic nerve, run forwards between the sclerotic and choroid coats, grooving the inner surface of the former, and supplying the latter; then, finally dividing each into two branches, penetrate the ciliary ligament, and are lost in the ciliary processes and iris. The long ciliary arteries, two in number, arise more regularly from the ophthalmic; they run forwards, along the lateral surface, and on a level with the axis of the globe of the eye, between the conjunctiva and sclerotic coat, and at a point about a line distant from the edge of the cornea they perforate the sclerotic coat, and terminate in the ciliary processes and iris. In introducing the needle into the globe of the eye, in the operation of cataract, &c., these vessels should be avoidod by passing the instrument a short distance beneath them. The *anterior* ciliary arteries are in general derived from the muscular branches of the ophthalmic; they perforate the sclerotic coat about one or two lines distant from the cornea, and terminate with the preceding in the ciliary processes and iris. The anterior and long ciliary arteries form a vascular zone round the cornea, which is particularly manifest in iritis, and other deep-seated inflammations of the eye.

5. *Arteriæ musculares,* irregular as to number and size, are distributed to the muscles of the orbit and the lid.

6. *Arteriæ ethmoidales,* two in number, arise from the ophthalmic artery on the inside of the optic nerve, pass, one through the foramen orbitale internum posterius, the other through the foramen orbitale internum anterius, along with the nasal nerve; they sparingly supply the dura mater, and are lost in the mucous membrane of the ethmoid cells and nose.

7 and 8. *Arteriæ palpebrales, superior and inferior,* pass forwards from the orbit, the superior one above, the inferior one below the tendon of the orbicularis muscle, to the supply of the upper and lower lids, the caruncula lacrymalis and lacrymal sac.

9. *Arteria nasalis* escapes from the orbit between the pulley of the superior oblique muscle and the tendon of the orbicularis palpebrarum to the side of the nose, on which it is lost.

10. *Arteria frontalis* is the last terminating branch of the opthalmic artery; it escapes from the orbit with the preceding, but turns upwards to the supply of the occipito-frontalis and corrugator supercilii muscles and integuments of the forehead.

Shortly after the origin of the ophthalmic artery, the internal carotid divides into its terminating branches.

1. *Ramus communicans posterior* is in general the first and the smallest of the three terminating branches; it runs backwards and inwards for about an inch between the arachnoid membrane and the pia mater, and to the outer side of the infundibulum and corpora albicantia, and unites with the posterior cerebral artery, thus com-

pleting the circle of Willis. Some small branches proceed from this artery to the surrounding pia mater.

2. *Arteria cerebri anterior* ascends forwards and inwards between the optic and olfactory nerves, above the former, and below the latter, and arrives at the fissure which separates the anterior lobes of the brain; it here approaches its fellow of the opposite side, and becomes united with it either by a meeting of the two trunks or by means of a transverse branch, named the anterior communicating artery. The trunks again proceed forwards along the under surface of the corpus callosum, hence named the arteries of the corpus callosum, wind round its anterior extremity, then run backwards along its upper surface, and soon divide each into two branches: one of which continues along the corpus callosum to the posterior extremity, where it is lost in the inner surface of the lateral hemisphere of the brain: the other passes off directly from the corpus callosum on the lateral hemisphere, in which it is lost.

3. *Arteria cerebri media* is the largest of the three terminating branches of the internal carotid; from its origin it turns outwards and backwards into the fissure of Sylvius, and then, winding upwards and outwards, divides into numerous branches, which, breaking down in the pia mater, supply chiefly the anterior and middle lobes of the brain.

Few circumstances have more influence on the operations performed by the surgeon on the arteries of the neck and upper extremity, whether for the removal of aneurism, or for the restoring of arterial hemorrhage in cases of wounds, where the principal branches of the carotid arteries are wounded, than the free amastomosis which exists between all the vessels of the brain. In the operation for aneurism, this fact should banish from the mind all apprehensions of a deficient circulation, so long as the arteries of one side remain perfect, nay, we might almost venture to say, as long as even one vessel is left to convey the blood to the brain.

ANATOMY OF THE PHARYNX AND MOUTH.

The examination of these parts is best conducted by detaching them from the anterior part of the vertebral column. For this purpose make a transverse incision through the trachea and œsophagus, a little above the sternum and down to the vertebral column; raise these from the spine, together with the vessels and nerves on either side; dissect them gradually upwards, as far as the basilar process of the occipital bone; now, either separate the head at the articulation with the atlas, or saw it through from below upwards, by placing the saw nearly flat upon the vertebræ, inclining its edge at the same time a little backwards. The section having been made, the pharynx should be first studied.

THE PHARYNX

is a musculo-membranous bag or reservoir, deficient anteriorly, and extends from the occipital bone to the fourth or fifth cervical vertebra, where it terminates in the œsophagus, exactly opposite the termination of the larynx in the trachea. It is expanded above and in the centre, but is contracted towards its termination. Posteriorly it rests on the vertebral column, with the intervention of the anterior common ligament, the rectus capitis anticus major and longus colli muscles. It is connected with these parts by a quantity of loose reticular cellular tissue, which allows of its free motion.

This cellular tissue is sometimes the seat of collections of pus, either from phlegmonous or erysipelatous inflammation, but still more frequently from a carious state of the bodies of the cervical vertebræ. In such cases, the matter proceeds forwards, so as to form a convex swelling at the back of the pharynx, distinguishable on looking into the cavity of the mouth, and at once recognized by a feeling of fluctuation. When the matter accumulates in large quantities, it presses so far forwards as to impede the acts of deglutition and respiration. When such is the case the pus should be discharged by the trocar and canula. These instruments having been passed through the mouth into the swelling, the trocar is to be withdrawn, so as to allow of the escape of the fluid along the canula. If a less cautious proceeding be adopted the matter may flow into the larynx, and so cause the suffocation of the patient.

The looseness of the reticular cellular tissue, at the back of the pharynx, allows of the formation of those cul-de-sacs, sometimes developed in it, and as described by Dr. Baillie.

Anteriorly the pharynx is related from above downwards to the posterior nares and Eustachian tubes, the velum palati, the isthmus faucium, the root of the tongue, the glottis, and the back of the larynx. On each side of the pharynx are the common carotid arteries and their branches, the internal and external carotids, together with the lingual, pharyngeal, and superior thyroid branches of the former. Of these the internal carotid lies in closest contact, especially towards its upper part, and is hence, as well as from its great size, one of the most important relations of this cavity.

On each side of the pharynx several nerves also are to be noticed: these are the par vagum, which descends in the neck between the carotid artery and external jugular vein; the glosso-pharyngeal, which winds round the stylo-pharyngeus muscle, to be lost in the pharyngeal plexus; the lingual nerve, and the gustatory branch of the fifth, which winds beneath the side of the tongue, under the mucous membrane of the mouth, to be lost in the papillæ of the tongue.

The pharynx is attached superiorly by means of the numerous connexions of its superior constrictor, and of a dense fascia or aponeurosis, better marked on the mesial line than on either side, to the basilar process of the occipital bone, to the petrous bone, and the hamular process of the internal pterygoid plate of the sphenoid bone; descending from this, the fascia covers the muscular fibres of the pharynx, and is attached with them to the os hyoides and sides of the larynx and trachea; it is not so well marked inferiorly. This fascia is no doubt of use in preventing the over-distention of the pharynx. Beneath this lie the muscles of the pharynx. These present an arrangement not to be met with in any other part of the body; that is, overlapping one another from below upwards. They are symmetrical, and consist of three pairs of muscles, named from their office the constrictors of the pharynx, superior, middle, and inferior. They have all one common attachment to the mesial line posteriorly, and by means of this to the basilar process of the occipital bone. The fleshy fibres of the inferior constrictor above do not reach the occipital bone. A small semicircular space, in which the muscular fibres are deficient, exists *superiorly*, between the occipital and temporal attachments of the superior constrictor named the *sinus of Morgagni;* this corresponds internally to the opening of the Eustachian tube; between the temporal and pterygoid attachments of this muscle the muscles of the velum lie; between its pterygoid and maxillary attachments the internal pterygoid muscle and the gustatory nerve are situated.

The pharynx is lined internally by mucous membrane. This is continuous above with that lining the nares, Eustachian tubes, fauces, and larynx, and inferiorly descends into the œsophagus. This is lined by a thin layer of cuticle, named the epithelium, continued from the external integuments through the mouth, pharynx, œsophagus, as far as the stomach, at the cardia of which it terminates in a fringed margin or extremity. The *epithelium* is of use in protecting the mucous membrane of the pharynx from the contact of foreign bodies. It is frequently raised in the form of vesications, by the swallowing of boiling water or other irritants, as also in apthæ, small-pox pustules, &c.

The mucous membrane of the pharynx is of a pale rose pink colour. It contains a number of mucous follicles, which, together with the surface of the membrane and the tonsils, pour out a quantity of mucus which serves to moisten the food and protect the membrane. The pharynx receives its supply of blood principally from the pharyngea ascendens artery, a few branches are also distributed to it from the palatine, the superior and inferior thyroid arteries. Its nervous supply is derived from the pharyngeal plexus.

In the quiescent state, the pharynx is closed by the approximation of its anterior and posterior walls, except superiorly, where it is capable of but little alteration, in consequence of its fixed bony attachments. When, however, the food is about to enter its cavity, it becomes dilated, from before backwards, by the larynx being drawn upwards and forwards beneath the tongue, and from side to side, by the stylo-pharyngeus and palato-pharyngeus muscles; the food now drops into its cavity, thus formed to receive it, and immediately the constrictors contract from above downwards, and force it into the œsophagus. The stylo-pharyngei are the muscles principally employed in increasing the transverse diameter of the pharynx.

As the pharynx is most contracted at its lower parts, foreign bodies are most likely to be stopped in this situation. Should the body not be speedily removed suffocation will be the consequence, produced by a spasmodic contraction of the constrictor muscles of the larynx, between which and the pharynx a powerful sympathy exists. In such cases, the surgeon should instantly pass his fingers into the mouth of the patient, and thus endeavour to extract the foreign body; if this should fail, the probang is to be passed downwards, and thus the substance be dislodged. Passing the probang is a simple operation: introduce the two forefingers of the left hand into the patient's mouth, so as to depress the root of the tongue, and guide the instrument; now pass the probang, pushing it backwards, until it strikes against the posterior wall of the pharynx, and push the instrument downwards and backwards; by these means it will be forced to proceed downwards and descend into the pharynx. In passing the probang the tongue should not be drawn forwards, for by so doing the epiglottis is raised, and the glottis or upper opening of the larynx is left unprotected, and the instrument may thus pass into the larynx. The same directions will serve to guide the practitioner in the introduction of the tube of the stomach-pump. Elastic tubes are also passed into the stomach through the pharynx, in cases of wounds of the larynx, in attempts at suicide, or in diseases of this part, where deglutition cannot be performed without imminent risk to the patient. In these instances it is preferred to pass the instrument through the nares, as they thus cause less disturbance to the patient.

When the pharynx is opened from behind, several openings and other important parts forming its anterior boundaries are brought into view. We shall examine them from above downwards.

The *posterior nares* are situated immediately above the velum; they are of an oval shape, or rather quadrilateral, with the long axis directed downwards, and slightly forwards, and with angles rounded off. Each is bounded *above* by the body of the sphenoid bone, *below* by the palatine process of the palate bone, *externally* by the inner surface of the internal pterygoid plate, *internally* by the posterior margin of the vomer, which forms the septum of the posterior nares.

On each side of the posterior nares, and opposite the posterior extremity of the inferior spongy bone, is the *opening* of the *Eustachian tube;* this is circular and somewhat trumpet-shaped, and is directed forwards and inwards towards the septum narium, and is formed of cartilage, lined by mucous membrane. Through the opening of each Eustachian tube a probe may be passed along the middle meatus, into the tube itself, for the removal of any obstruction which sometimes exists in it and produces deafness. The probe should be first bent for this purpose, and then directed backwards and outwards along the meatus. Beneath the posterior nares is the

VELUM PENDULUM PALATI, OR SOFT PALATE.

This is a soft musculo-membranous septum, which partially divides the upper from the lower part of the pharynx, and separates the cavity of the mouth from the posterior nares. It is somewhat quadrilateral in shape; one margin is turned upwards and forwards, and is attached to the hard palate and posterior edge of the palate bone; the other margin is free, and is directed downwards and backwards, and has the uvula depending from its centre, on each side of which it is arched, forming the half arches of the palate; on either side, the velum is attached, by means of the pillars of the fauces, to the tongue and pharynx.

One surface of the velum is turned forwards and slightly downwards, the other is directed backwards and a little upwards; they both vary much in position according to the action of the muscles. In structure, the velum is composed of muscular fibres, glands, blood-vessels, and nerves, covered by mucous membrane. The proper muscular fibres consist of three muscles on either side, viz., the *levator palati*, *tensor palati*, and *motor uvulæ.*

The *glands* in the velum are most numerous on its anterior surface; they lie immediately beneath the mucous membrane. The use of the velum is to prevent the food from passing, during the act of deglutition, upwards from the pharynx into the posterior nares. It is also of service in modulating the tones of the voice.

The *uvula* is a conical projection pendent from the lower margin of the velum on the mesial line; it is composed of mucous membrane, inclosing a quantity of cellular tissue, some glands, and a few muscular fibres; its use is to announce, as it were, to the velum the approach of the alimentary bolus.

The uvula becomes occasionally elongated from effusion into its cellular tissue, the result of acute or chronic inflammation, and is a source of much annoyance from its touching, and thus irritating, the glottis, or upper opening of the larynx. Should the effused fluid not become absorbed, a portion of the uvula may be removed with the scissors.

Immediately beneath the velum is the *isthmus faucium*, leading into

THE CAVITY OF THE MOUTH.

The oral cavity is best examined from behind; irregular as to size and shape, it is bounded *in front* by the lips, *superiorly* by the hard palate, *inferiorly* by the tongue, and *laterally* by the cheeks. *Posteriorly* it communicates with the pharynx, larynx, and posterior nares, by the isthmus faucium, an irregular opening transversely oval, bounded above by the soft palate, below by the root of the tongue and epiglottis, on each side by two crescentic folds of mucous membrane, named the arches of the palate, between which lies the tonsil or amygdala.

The lips are formed by muscular fibres, glands, and cellular tissue (considered by some to be of an erectile nature), covered by mucous membrane. The glands in the lips are named labial glands; they lie beneath the mucous membrane, and are more abundant in the lower than in the upper lip. One or more of these glands is frequently affected with cancer in the adult male subject.

The cheeks are composed of skin externally, mucous membrane internally, between which are placed the buccinator muscles, and a quantity of adipose tissue. Each is perforated by Steno's duct, opposite the second molar tooth of the upper jaw.

The hard palate or roof of the mouth is formed by the palatine processes of the superior maxillary and palate bones, covered by a dense fibro-mucous membrane, marked irregularly with transverse projections.

The tongue is of a triangular shape; its base is thick and broad, and is connected in the centre to the epiglottis by folds of mucous membrane; on each side, to the soft palate, by the pillars of the fauces; and more inferiorly, to the os hyoides and lower jaw, by muscles: its apex is thin and free. Between the apex and base of the tongue is the *body*. The upper surface of the tongue, called also the dorsum, is slightly convex on each side, a little depressed in the centre; it is covered by mucous membrane, and presents a number of eminences, named papillæ: these are classed into three sets or orders, viz., the *conical*, which are small, and occupy the anterior part of the tongue, and are endowed with the sense of taste; the *lenticular*, varying from nine to fifteen in number, are situated near the base of the tongue, in the form of a V, the apex being turned backwards, and corresponding to a foramen varying in size and depth, named the foramen cœcum; the *fungiform*, more numerous than the preceding, are placed near to the sides and tip of the tongue. The under surface of the tongue is but partially covered by mucous membrane, a fold of which, named *frænum linguæ*, connects it to the inner surface of the symphysis of the inferior maxilla. In it may be perceived the ranine veins, one on either side of the mesial line, and a peculiar fringed arrangement of the mucous membrane. The Whartonian ducts open on the frænum linguæ: these orifices are indicated by projections of the mucous membrane in the form of papillæ. The substance of the tongue is composed of a peculiar fleshy mass, by some supposed to be muscular, by others erectile in its nature, intermingled with fat, the fibres of the stylo, hyo, genio, and palato-glossi and linguales muscles, arteries, and nerves. In the centre of the tongue, running from behind forwards, is a fibro-cartilaginous septum, which divides it imperfectly into two lateral portions; this is more perfect behind than in the anterior portion. The principal arteries of the tongue are the dorsalis linguæ and the ranine branches of the lingual artery. The nerves of the tongue are numerous, and are derived from the gustatory branch of the fifth which supplies the organ with the sense of taste, from the lingual which supplies the muscles, and from the glosso-pharyngeal which are supposed to associate the tongue with the pharynx, velum, &c. in the act of deglutition.

The interior of the mouth is lined with mucous membrane, which is continuous externally with the integuments, and from thence passes inwards, covering the free margin of the lips, and their inner surface, as also that of the cheeks; it is thence reflexed on the alveolar processes of the upper and lower jaw, passes between the teeth, covering the gums, and from the inner surface is reflexed on the hard palate above, the sublingual gland and muscles of the tongue below, from whence it is reflexed on the tongue itself, covering this organ as just described; from these parts it passes on to the velum towards the larynx, pharynx, posterior nares, and Eustachian tubes. In this course it forms several folds, the most remarkable of which are the frænula labiorum, two folds which connect the upper and lower lips to the alveolar processes; the frænum linguæ, and the frænum and frænula of the epiglottis. The mucous membrane of the mouth is covered by the epithelium.

The mouth communicates posteriorly with the pharynx, larynx, and posterior nares, by means of the *isthmus faucium*, the lateral boundaries of which are the pillars of the fauces and the tonsils. The *pillars of the fauces* are two crescentic folds of mucous membrane on each side, within which are muscular fibres. The anterior pillar descends from the edge of the velum forwards and outwards to the side of the base of the tongue, and incloses between its folds the palato-glossus muscle. The posterior fold descends backwards and outwards, and is lost on the lateral surface of the pharynx; it incloses the palato-pharyngeus muscle. These folds, from their possessing muscular fibres, are enabled to constrict or close the isthmus faucium, hence they have been named by some constrictores isthmi faucium; they can also compress the tonsil which lies embedded between them, and thus force out its secretion in the acts of mastication and deglutition. The palato-pharyngeus muscle can somewhat dilate the pharynx in the transverse direction.

The *tonsil* or *amygdala* is lodged in the triangular interval between the pillars of the fauces. It is ovoid in shape, with the larger extremity turned upwards; it is composed of a congeries of mucous follicles, covered by mucous membrane. Its free surface is irregular, in consequence of the number of orifices of the mucous follicles. Its outer surface rests against the superior constrictor of the pharynx. The tonsil receives its supply of blood chiefly from the tonsillitic branch of the labial artery; its nerves are derived from the tonsillitic plexus, formed by branches from the lingual, glosso-pharyngeal, and sympathetic nerves.

The tonsils are subject to attacks of acute and chronic inflammation (cynanche tonsillaris). In the former case, matter frequently forms in the gland and requires to be let out in consequence of the uneasiness it produces, and also from the enlargement interfering with respiration and deglutition. Much caution should be observed in opening these abscesses, as the gland is closely related on its outer surface to the internal carotid artery. The instrument selected for the purpose should be directed backwards, or backwards and inwards; if directed outwards the artery is in much danger. An emetic will often succeed in causing the abscess to burst. We have found scarification of the tonsil very beneficial, for the flow of blood assists in lessening the inflammation, and, should matter form, it more easily makes its way through either of the scarifications. The tonsil becomes much enlarged after it has been subjected to repeated attacks of inflammation: it then forms a chronic swelling, which distresses the patient much by impeding the action of respiration and deglutition. Not unfrequently, too, the hearing becomes impaired from the pressure of the tumour on the Eustachian tubes. Should local applications be found insufficient to produce the absorption of the swelling, a portion of it may be removed with the ligature or the knife. This latter method, although frequently practised on the continent with success, is not free from danger. If the surgeon determines on its adoption, the gland should be carefully drawn forwards from its deep relations, by the tenaculum passed through it, and then the part be removed. After the operation some styptic, such as a strong solution of nitrate of silver, sulphate of zinc or copper should be applied to the bleeding surface in order to check the hemorrhage. Ulcers occasionally form on the tonsil from acute, but more frequently from the venereal inflammation.

The *glottis* or superior opening of the larynx is situated immediately behind the root of the tongue and epiglottis, and beneath the velum.

The relative position of this opening should be attentively considered, as it is frequently found necessary to pass tubes through it into the larynx, for the purpose of artificially inflating the lungs. If some caution be not observed in the introduction of these instruments, it is evident that they may be passed down the pharynx and not into the larynx. To avoid this mistake, the tongue should be drawn forwards, so as to raise the epiglottis and thus uncover the glottis; the instrument being then passed through the mouth, and guided by the fingers of the left hand, will descend into the larynx. It is much easier to pass an instrument through one of the nares into the larynx than through the mouth; and this method should be adopted for obvious reasons, whenever it may be necessary to leave the instrument in for any length of time. The greater facility is attributed to the glottis being almost directly beneath the posterior nares; more probably it is owing to the point of the instrument being turned forwards towards the larynx from its striking against the back of the pharynx.

DEEP MUSCLES OF THE NECK.

Behind the pharynx and larynx, and closely connected to the spine, are the deep muscles of the neck, forming the third layer of cervical muscles; they are seven in number on each side, and consist of

Longus colli.
Rectus capitis anticus major.
.... *minor.*
.... *lateralis.*
Scalenus anticus.
.... *medius.*
.... *posticus.*

The scaleni are of most importance from their surgical relations than from any other circumstance. On the anterior surface of the scalenus anticus muscle, we find the subclavian vein, the transversales colli and humeri arteries, which cross the muscle transversely, and the phrenic nerve, which takes a perpendicular direction. Between the scalenus anticus and medius the subclavian artery and brachial plexus pass outwards. Occasionally, one of the branches of this plexus separates the scalenus medius and posticus. The outer edge of the scalenus anticus muscle guides us to the subclavian artery, where it rests on the first rib. Its inner margin is bounded by the vertebral artery.

At the root of the neck, and a little above the clavicle, crosses

THE SUBCLAVIAN ARTERY.

The subclavian arteries, like the carotids, differ on the right and left sides.

Arteria subclavia sinistra arises from the extreme left of the transverse portion of the arch of the aorta, opposite the left side of the second dorsal vertebra, and close to the origin of the left carotid; it thence ascends almost perpendicularly out of the thorax into the neck, turns outwards and passes behind the scalenus anticus muscle. In this part of its course the left subclavian artery lies deep, being covered by the cone of the left pleura and the apex of the left lung, which lie also a little to its outer side. Anterior to it are also the left par vagum, the left carotid, the left internal jugular vein and vena innominata, also the sternum, first rib, and clavicle, the sterno-mastoid, sterno-hyoid, and sterno-thyroid muscles. Posterior to it are the spinal column, the longus colli muscle, the inferior cervical ganglion of the sympathetic and the thoracic duct; the œsophagus lies also behind it, but a little to its right side. The left recurrent nerve hooks round the arch of the aorta, close to the origin of the left subclavian artery, and then ascends internal and posterior to it.

Arteria subclavia dextra arises from the arteria innominata, opposite the right sterno-clavicular articulation, ascends outwards, and passes, like the left subclavian, behind the scalenus anticus muscle. In this part of its course, the right subclavian artery is much more superficial than the left; it is covered by the integuments, platysma, cervical fascia, the sterno-mastoid, sterno-hyoid, and sterno-thyroid muscles, by small branches of veins and nerves, and by the conflux of the internal jugular and subclavian veins, which unite in front of it, but towards its outer part, to form the right vena innominata. It is more immediately invested by a dense layer of cellular substance or fascia, continuous inferiorly with the fibrous layer of the pericardium, and superiorly with the sheath of the carotid vessels. On removing a part of this the subclavian artery is exposed between the conflux of the internal jugular and subclavian veins on the outer side, and the carotid artery on the inner side, forming a vascular triangle before alluded to, the base being the subclavian artery: here the vessel is crossed by the par vagum and recurrent nerve, and the cardiac filaments of the sympathetic; the phrenic nerve crosses the artery a little to the outer side of them, beneath the conflux of the internal jugular and subclavian veins. It is also sometimes crossed by the vertebral veins. Posterior to the artery, in this stage, are the inferior laryngeal or recurrent nerve, the sympathetic and first dorsal nerves, the spinal column, and the longus colli muscle; more externally, it rests on the cone of the pleura.

In the first stage only, as above described, the right and left subclavian arteries differ. The chief points of difference may be summed up as follows: the right arises from the arteria innominata, the left from the arch of the aorta; the right is larger but shorter than the left, is more superficial and takes a more transverse course, and differs in its relation to the par vagum and vena innominata; the left only is related to the thoracic duct and œsophagus, and is more connected with the pleura. From the first stage each artery passes almost horizontally outwards between the scaleni muscles and at the outer margin of the scalenus anticus, descends on the first rib, at the lower border of which it sinks beneath the clavicle, and terminates by becoming the axillary artery, forming an arch, convex upwards, which extends into the neck as high as the fourth or fifth cervical vertebra.

The subclavian artery has been divided, for the purposes of description, into three stages: the *first* or *ascending* extends from the origin of the vessel to the inner border of the scalenus anticus muscle; the *second, transverse*, or *middle* stage, is the portion of the vessel which lies between the scaleni muscles; the *third* or *descending* stage extends from the outer border of the scalenus anticus muscle to the lower margin of the first rib.

In the second or middle stage the subclavian artery rests on the middle scalenus muscle and the cone of the pleura; the brachial plexus lies above and posterior to it; in front of it are the integuments, platysma, and sterno-mastoid and scalenus anticus muscles; on the anterior surface of this last the subclavian vein, the transversales colli and humeri arteries, and the phrenic nerve. In its third stage the subclavian artery lies in the posterior inferior triangle of the neck, bounded by the omo-hyoid muscle externally, the sterno-mastoid scalenus anticus muscles internally, and the clavicle inferiorly; it is covered only by the integuments, platysma, and a quantity of cellular membrane, which contains several branches of the cervical and brachial plexus, the subclavian, external jugular, and other veins, and the transversales colli and humeri arteries; it rests on the first rib, which separates it from the pleura; the brachial plexus lies above and posterior to it; the subclavian vein lies anterior and inferior to it. The subclavian arteries are improperly so called, as they are not beneath the clavicle in any part of their course, if we except a portion of the first stage of the left subclavian.

OPERATIONS ON THE SUBCLAVIAN ARTERIES.

The subclavian artery may be tied in its first stage, if wounded here; also for the cure of aneurism, if in its second or third stages, or in cases of hemorrhage resulting from the operation of tying the vessel in these stages; or as has been lately recommended for the cure of aneurism of the arteria innominata, on the principle first laid down by Brasdor, and more lately advocated by Mr. Wardrop.

To *tie the artery in its first stage* on the right side, place the patient in the horizontal posture, with his head gently supported by pillows, and turned towards the opposite side. Make an incision, about three inches in length, along and a little above the clavicle, commencing at its sternal end, from the inner extremity of which carry another upwards along the external margin of the sterno-mastoid muscle, to the extent of about two inches and a half; in these incisions, the integuments, platysma, and fascia are divided; raise a triangular flap so as to expose the lower part of the sterno-mastoid muscle, behind which pass a director and cut through it; the sterno-hyoid and sterno-thyroid muscles are now exposed, with a few branches of the descendens noni nerve; they may be divided in like manner or drawn inwards. By a little farther dissection the right vena innominata is exposed, formed by the junction of the internal jugular and subclavian veins. Tear through some cellular substance and the artery will be brought into view, forming the base of the vascular triangle, as already described: draw the par vagum, recurrent, and sympathetic filaments to the inner (for if the par-vagum be drawn externally the recurrent nerve is sure to be included in the ligature) side, depress the vena innominata towards the thorax, and pass the aneurism needle from below upwards, taking care to avoid the parts which lie behind the vessel. It is seldom that the phrenic nerve is exposed in performing this operation, as it lies either on or close to the scalenus anticus muscle.

There is only a space of about three quarters of an inch between the origin of the subclavian artery and the part from whence it gives off its branches, where the vessel can be safely tied. The ligature should be applied about midway between these two points, or perhaps a little nearer its first branch, in order that as much space as possible may be left for the formation of an internal coagulum and the subsequent contraction of the vessel. Although the subclavian artery has now been frequently tied in its first stage, we regret to say, that no favorable case has yet occurred; nor, indeed, can we be surprised at this want of success, when we reflect upon the contiguity of the arteria innominata and carotid arteries, on the short space there is for the application of a ligature, and on the numerous important parts that are disturbed during the performance of the operation. It has been of late suggested by Mr. Hayden to secure, at the same time, the common carotid, so as to cause the obliteration, if possible, of the arteria innominata by securing its two branches: this is a valuable suggestion which has been acted upon in two instances during the past year. The possibility of tying the left subclavian artery, in its first stage, has been, and is still, questioned; notwithstanding, we have no hesitation in giving it as our opinion that it is practicable, and that the difficulties are not of such a nature as should deter the surgeon from undertaking its performance, when such becomes necessary for saving the life of his patient. One great objection to its trial is that Sir A. Cooper attempted this operation, and was forced to abandon it.

The subclavian artery may be tied in its second stage for the cure of aneurism of the axillary artery, extending to the third stage of the subclavian. For this purpose (the patient being placed as in the preceding operation) make an incision of about three inches long, and a little above the clavicle, commencing at a short distance from its sternal end; divide the integuments, platysma, fascia, and clavicular portion of the sterno-mastoid muscle, the last on the director; the subclavian vein, transversalis colli, and humeri arteries, and phrenic nerve are exposed on the anterior surface of the scalenus anticus muscle. These several parts having been drawn out of the way, pass a director behind the scalenus anticus muscle and divide it; the subclavian artery will now be brought into view; pass the aneurism needle from below upwards, taking care to avoid the cone of the pleura, which lies behind the artery and the brachial plexus of nerves. The dangers of this operation are only counterbalanced by one advantage, viz., that the subclavian vein is separated from the artery by the scalenus anticus muscle; this is not sufficient to induce the surgeon to risk its performance when the artery may be secured in the third stage, or we would almost say even in its first stage.

The third stage of the subclavian artery is the most favorable for the application of the ligature; it is tied for aneurism of the axillary artery or of the brachial artery high up. To secure it in this situation place the patient in the horizontal position, with the head and neck turned towards the opposite side, and the shoulder depressed as much as possible; make an incision along and a little above the clavicle, commencing at the outer edge of the sterno-mastoid muscle, or a little internal to the centre of the bone, and terminating near its acromial end; in this the integuments, platysma, and a few of the supra-clavicular branches of the cervical plexus will be divided. A quantity of cellular tissue is now exposed, filling the posterior inferior triangle of the neck; in this are contained some branches of the cervical and brachial plexuses, lymphatic glands, and a number of small veins crossing from the posterior part of the neck to terminate in the external jugular vein, which lies close to the outer margin of the sterno-mastoid muscle. Tear through this cellular tissue, taking care to avoid, if possible, the several parts just mentioned. In some subjects the clavicular portion of the sterno-mastoid muscle encroaches on the space and will require division.

On continuing the dissection more deeply the omo-hyoid muscle will be brought into view, crossing the upper part of the space; this being drawn upwards, the subclavian vein and transversalis humeri artery will be exposed in the base of the triangle, and the transversalis colli artery in its apex; separate these parts, and expose the outer edge of the scalenus anticus muscle; pass the finger downwards along this, and it will thus be conducted to the subclavian artery, where it rests on the upper surface of the first rib. As the brachial plexus lies in close contact with the artery, it is possible that one of its branches, and most likely the central one, from its running a long course before it joins the plexus and from its proximity to the artery, may be mistaken for the subclavian artery. Detach the artery from its surrounding connexions and pass the aneurism needle from below upwards and a little from within outwards. Should it be found difficult to pass the needle in this direction (as it sometimes is from the position of the clavicle,) it may be passed in the contrary direction. In doing so, the subclavian should be carefully protected with the point of the finger. If any difficulty be experienced from the depth of the wound in making the knot sufficiently secure, the serre-nœud should be made use of.

The operation of tying the subclavian artery in its third stage has been now so frequently performed with success, that no question can be entertained as to the propriety of its adoption in all cases in which it may be considered necessary.

We may here observe that in the performance of all operations, even the smaller veins should be avoided, as the hemorrhage which ensues from them when divided, by obscuring the parts, adds much to the embarrassment of the surgeon. It may appear extraordinary that a nerve should be mistaken for an artery, but it should be recollected that the blood discolours the nerve, and that a pulsation is frequently communicated to it by the artery; under these circumstances the mistake is not at all an unlikely one, and has been more than once committed.

The principal *branches* of the subclavian artery are five in number, three of which are given off from its first stage, viz. the vertebral, internal mammary, and thyroid axis, and the remaining two in its second stage, viz. the cervicalis profunda, and the superior intercostal.

The branches which arise from its first stage are given off from a very small portion of the artery near to the inner margin of the scalenus anticus muscle.

Arteria vertebralis, is in general the first and the largest branch of the subclavian, from the upper and posterior part of which it arises; from this it passes upwards, backwards, and a little outwards, sinks into a triangular fossa, between the longus colli on the inner, and the scalenus anticus muscle on the outer side, and enters the foramen in the transverse process of the sixth or fifth cervical vertebra, sometimes that of the fourth, but very rarely of the seventh. It then ascends in the foramina of the transverse processes of the cervical vertebræ, anterior to the spinal nerves, until it has passed through the foramen of the vertebra dentata; it here winds outwards, then turns inwards, passes obliquely upwards and outwards, through the foramen in the transverse process of the atlas, winds backwards around the occipito-atlantoidean articulation, enters a triangular space formed by the recti postici muscles posteriorly, the superior oblique superiorly, and the inferior oblique inferiorly; it here runs inwards in a groove on the upper surface of the atlas, and perforates the posterior broad ligament, sometimes above, sometimes below the suboccipital nerve; the artery thence ascends forwards and inwards through the foramen magnum, enters the cavity of the cranium, and at the inferior margin of the pons varolii, unites with the vertebral artery of the opposite side, to form the basilar artery.

In the neck the vertebral artery gives off some branches of minor importance to the surrounding muscles; a few pass from it, which, conducted by the spinal nerves, enter the spinal canal to supply the spinal marrow. Between the atlas and cuneiform process, the vertebral gives off a few branches to the dura mater, also the arteria cerebelli inferior, and the arteriæ medullæ spinalis, anterior and posterior.

Arteria cerebelli inferior sometimes arises from the basilar artery, runs backwards and downwards between the par vagum and spinal accessory nerves, to supply the inferior and posterior parts of the cerebellum.

Arteriæ medullæ spinalis, anterior and posterior consist of two on each side, one in front and one behind, which descend on the anterior and posterior surfaces of the spinal marrow, to its inferior extremity. anastomosing freely with each other and with branches distributed to the spinal marrow, from the vertebral, intercostal, and lumbar arteries, n the cervical, dorsal, and lumbar regions.

The *basilar artery* formed, by the junction of the two vertebral arteries, ascends in a groove in the anterior surface of the pons varolii, bound down by the arachnoid and pia mater, and between the sixth pair of nerves, and at its upper extremity near to the posterior clinoid processes of the sphenoid bone, divides into its four terminating branches, two to either side, viz. the arteriæ cerebelli superiores and arteriæ cerebri posteriores.

Arteria cerebelli superior vel *anterior*, on each side, winds backwards and outwards round the upper part of the pons varolii to supply the upper surface of the cerebellum, the tubercula quadrigemina, &c. A small branch from it frequently enters the meatus auditorius internus between the portio dura and portio mollis of the seventh pair of nerves.

Arteria cerebri posterior, larger than the preceding, winds backwards and outwards around the crus cerebri to supply the posterior lobe of the cerebrum.

Between these two last-described arteries the third pair of nerves invariably passes out.

Shortly after its origin, the posterior artery of the cerebrum is joined by the posterior communicating branch of the internal carotid, and thus the circle of Willis is formed; this, which is an heptagon rather than a circle, is completed in front by the anterior arteries of the cerebrum and the anterior communicating branch, on each side by the internal carotid and the posterior communicating arteries, posteriorly by the trunk of the basilar and the posterior arteries of the cerebrum.

The vertebral artery, from its peculiar course, is almost precluded from any surgical interference.

The left vertebral, however, sometimes arises from the arch of the aorta, between the left carotid and left subclavian arteries: it then ascends into the neck, and frequently does not enter the foramina in the transverse processes of the cervical vertebræ, until it arrives opposite the second or third. Under such circumstances, it may be mistaken for the left carotid.

2. *Arteria mammaria interna* arises from the lower part of the subclavian artery, nearly opposite the vertebral. It passes downwards and forwards behind the phrenic nerve, and then enters the cavity of the thorax to the outer side of the nerve. It here descends along the outer margin of the anterior mediastinum, behind the sternal extremity of the costal cartilages, and covered by the triangularis sterni muscle and pleura, until it arrives at the diaphragm; it here enters the sheath of the rectus, and descends in it along the posterior surface of the muscle, and finally arrives opposite the umbilicus, where it terminates by anastomosing with the deep epigastric artery. In this course it gives off the *five anterior intercostal* arteries, which supply the anterior part of the five superior intercostal spaces, and anastomose with the intercostal arteries from the descending aorta, *mediastinal* branches which supply the fat and cellular tissue in the anterior mediastinum and the thymus gland in the fœtus, a small branch named *comes nervi phrenici* to accompany the phrenic nerve, a *diaphragmatic* branch which passes outwards, and is lost in the anterior attachments of the diaphragm and adjoining intercostal spaces; and lastly, muscular branches, to the rectus and transversalis muscles.

The anastomosis, between the internal mammary artery and the epigastric, is one of the most important in the human body, as it forms a direct communication between the vessels of the upper and lower extremities, and is thus of much service in re-establishing the circulation, when any of the vessels of either regions have been tied.

3. *Axis thyroidea* arises close to the inner margin of the scalenus anticus muscle, from the upper and fore part of the subclavian artery; it passes forwards and upwards, and after a short course, divides into four branches, the thyroidea inferior, cervicalis ascendens, transversalis colli, and transversalis humeri arteries.

Arteria thyroidea inferior runs upwards and inwards behind the sheath of the cervical vessels and the middle cervical ganglion of the sympathetic nerve, and on the left side behind the thoracic duct, and in front of the longus colli muscle, arrives at the side of the trachea and œsophagus, sends branches to these tubes, is joined by the recurrent nerve, and enters the posterior surface of the lateral lobe of the thyroid gland, where it ramifies, anastomosing with the superior thyroid artery from the external carotid, and the arteries of the opposite side.

Arteria cervicalis ascendens, is a small branch; it passes upwards along the origin of the scaleni muscles, and terminates by sending branches to the surrounding muscles, and anastomosing with descending branches from the occipital, sterno-mastoid, and vertebral arteries.

Arteria transversalis colli vel *scapularis posterior* is in general the largest branch of the thyroid axis. It bends outwards, in front of the scalenus anticus and phrenic nerve, crosses the apex of the posterior inferior triangle of the neck, runs between the branches of the brachial plexus, and enters the posterior superior triangle, where it terminates by dividing into two branches, the cervicalis superficialis, and the scapularis posterior.

The cervicalis superficialis divides into ascending and descending branches, which supply the glands, cellular tissue, and nerves, in the posterior superior triangle of the neck and the surrounding muscles; they anastomose above with descending branches from the occipital artery, and below with the branches of the suprascapular arteries.

The scapularis posterior is rather the continued trunk of the transversalis colli artery; it winds round the side of the neck, descends along the posterior border of the scapula, under cover of the levator anguli scapulæ, trapezius and rhomboid muscles, to which, and the adjoining muscles, it gives off numerous branches: it finally arrives at the inferior angle of the scapula, where it terminates by anastomosing with the branches of the subscapular artery and the infraspinous branches of the transversalis humeri artery.

Arteria transversalis humeri vel *suprascapularis*, like the preceding, crosses the scalenus anticus muscle and the phrenic nerve, enters the posterior inferior triangle of the neck, along the base of which it runs, but, a little below the clavicle, is joined by the suprascapular nerve, with which it passes outwards to the superior border of the scapula, where the nerve in general passes through the notch beneath the ligament, and the artery above it. The suprascapular artery enters the supraspinous fossa, gives branches to the supraspinatus muscle, descends beneath the acromion process behind the surgical neck of the scapula, and terminates in the infraspinous fossa, by dividing into numerous branches which supply the infraspinatus and teres minor muscles, and anastomosing with branches from the posterior scapular and subscapular arteries.

The transversalis colli and humeri arteries are engaged in the operations of tying the subclavian artery in its second and third stages. The free anastomoses maintained by them with each other, and with the subscapular and occipital arteries, serve to reestablish the circulation in the axillary and brachial arteries, when the subclavian artery has been tied.

The transversalis colli or humeri frequently arises from the third stage of the subclavian.

The subclavian artery gives off in its second stage the following:

Arteria cervicalis profunda passes backwards from the upper part of the subclavian artery, between the transverse processes of the fifth and sixth cervical vertebræ, ascends between the spinous and transverse processes of the vertebræ, supplies the deep muscles of the neck, and anastomoses with branches of the vertebral and occipital arteries.

Arteria intercostalis superior descends from the lower part of the subclavian artery in front of the neck of the first rib, to the outer side of the first dorsal ganglion of the sympathetic, then in front of the second and third ribs, and opposite each intercostal space sends off a branch, which passes outwards between the two layers of intercostal muscles, to which and the neighbouring muscles and the pleura it sends branches, and terminates by anastomosing with the intercostal arteries from the descending aorta, and with the external thoracic arteries. The left superior intercostal artery seldom supplies more than the two superior intercostal spaces.

The third stage of the subclavian artery seldom gives off any branch. It is the best situation for the application of pressure, when it becomes necessary to command the circulation of the axillary artery in amputation of the shoulder-joint.

THE SUPERIOR EXTREMITIES

Are connected to the upper posterior and outer part of the trunk, by means of the clavicle and numerous muscles. The examination of each extremity may be comprised under the heads of the axillary or scapulo-thoracic, brachial, anti-brachial, and palmar regions. Throughout these several regions, we have the subclavian artery continuing its course, under the separate heads of axillary and brachial artery, until it arrives opposite the coronoid process, where it terminates in the radial and ulnar arteries.

AXILLARY OR SCAPULO-THORACIC REGION.

Under this head is included the *axillary cavity*, with its different boundaries, viz. anterior, posterior, superior, and inferior.

The axillary cavity is a conical or pyramidal-shaped space, formed between the scapula and trunk. It is bounded *anteriorly* by the pectoralis major and minor muscles; *posteriorly* by the scapula, subscapularis, teres major, and latissimus dorsi muscles; *internally* by the ribs, covered by the serratus magnus; and *externally* by the neck of the humerus. Its apex, turned upwards, corresponds to the coracoid process of the scapula, its base or floor, directed downwards, is formed by the axillary fascia.

On stripping the integuments from the floor of the axilla, a dense fascia (the axillary fascia) is brought into view, attached in front to the edge of the pectoralis major muscle, behind to the lower margin of the latissimus dorsi, lost internally on the outer surface of the thoracic parietes, and externally continuous with the brachial aponeurosis. This fascia, although liable to much variety, is in general strong and well marked: it connects the walls of the axilla together, and assists in preserving the contents of the axillary cavity from pressure. It has much importance in practice, as it has the effect of resisting aneurismal or other tumours, abscesses, from making their way inferiorly: these, therefore, press upwards, and are frequently found to ascend into the neck, causing displacement of the clavicle, forcing backwards the scapula, and resembling diseases of the cervical region; not unfrequently axillary abscesses open in the neck above the clavicle, or in the small triangular space below this bone, and between the pectoralis major and deltoid muscles.

On removing this fascia, the axillary cavity is found to be filled with a quantity of fat and cellular tissue, in which are lodged numerous lymphatic glands, with the axillary vessels and nerves, and their principal branches. The nerves of Wrisberg are first met with; they cross the floor of the axilla, proceeding from the second and third intercostal nerves, and are lost in the integuments of the inside of the arm, as far down as the inner condyle. The cellular tissue of the axilla communicates freely with that of the neck, by means of a triangular opening between the clavicle, first rib, and scapula; by means of this, diseases of one region spread rapidly to the other, as may be observed in aneurisms, abscesses, emphysema, &c.

The lymphatic glands of the axilla communicate with those of the arm and thoracic parietes, and more especially of the mammary gland in the female; hence, when the latter structure is attacked with cancer, or other malignant disease, the morbid action is conveyed by means of the lympathics to the axillary glands; these become specifically affected, and will require removal together with the diseased breast. In doing so the greatest caution is necessary, as the axilla is surrounded on all sides, except its inner, by large and important vessels; thus, on the *outer* wall, the axillary vessels and nerves are placed, along its anterior wall, close to the margin of the pectoralis minor muscle is the thoracica longa, or external mammary artery, and along its posterior wall near the lower margin of the subscapularis muscle, is the subscapularis artery. It is evident, then, that in making an incision into this cavity for the removal of enlarged glands, one direction only can be given to the knife, viz., from without directly inwards. The same rule should be observed in opening abscesses. When the cavity has been exposed, the knife may be laid aside and the diseased glands be isolated by the fingers or a director, and then be forcibly torn away from the cavity. Some have recommended the division of the small vessels leading to the glands, but this is objectionable on account of the hemorrhage which frequently takes place, and as they retract into the cellular tissue are secured with difficulty; some have advocated the ligature of the arteries of the vessels of the glands, to produce a sloughing process, which, however, is tedious, painful, and unnecessary.

Remove the cellular tissue and glands, and the boundaries of the axillary cavity will be exposed. The anterior wall of the axilla is formed by the pectoral muscles. On raising the integuments and cellular tissue, a triangular space is exposed between the pectoralis major and deltoid muscles, with the base above at the clavicle and the apex below, lost in the cellular substance which connect these muscles inferiorly. Into this triangular space, the cephalic vein dips to unite with the axillary vein. More deeply seated in this triangular space are the costo-clavicular ligament, thoracica acromialis artery, the axillary artery and vein, and plexus of nerves. In this space the axillary artery is tied in its first stage, an operation that has but little to recommend it.

The pectoralis major muscle covers the upper and anterior part of the thorax; arises from the clavicle and the sternum, and the cartilages of the third, fourth, fifth, and sixth ribs, crosses in front of the axillary cavity, then sinks behind the deltoid muscle to be inserted into the outer edge of the bicipital groove, where it crosses the axilla; the sternal portion of the muscle passes hehind the clavicular.

This muscle with the latissimus dorsi, by their spasmodic contraction, frequently cause dislocation of the humerus into the axilla, particularly when the arm is raised from the side. In fracture of the neck of the humerus it also serves to displace the fractured ends of the bones. For this reason, in the treatment of such an accident, the muscle should be made as relaxed as possible by approximating the arm to the side. When making an examination of a cancerous breast, to ascertain whether the disease has extended to the muscular fibres, the arm should be separated from the side, so as to make this muscle tense. If we adduct the arm the muscle will move freely on the surface of the chest, together with the adherent diseased mass, and thus a wrong diagnosis may be formed.

Beneath the pectoralis major lies the *pectoralis minor*, extending from the third, fourth, and fifth ribs, to be inserted into the inner edge of the coracoid process. In fractures of the neck of the scapula it tends to separate the fractured extremities of the bone. It crosses the axillary artery, and thus produces a division of this vessel into three stages.

Beneath and a little below the clavicle lies the subclavius muscle. This arises from the cartilage of the first rib, and is inserted into the under surface of the clavicle, as far as the interval between the conoid and trapezoid ligaments. In fractures of the clavicle this muscle tends to draw the outer portion downwards and inwards.

On cutting across the pectoralis minor muscle, and removing some cellular tissue, the axillary artery, vein, and nerves are exposed.

THE AXILLARY ARTERY

Commences at the lower margin of the first rib, from which it passes downwards, outwards, and backwards, across the axilla and along the inner and upper part of the arm, until it arrives at the lower margin of the teres major and latissimus dorsi muscles, where it becomes brachial. In this course it forms a curve, the convexity of which is turned upwards and outwards. It is closely accompanied by the axillary or brachial plexus of nerves, and the axillary vein or veins which obscure it from view.

For the purpose of description the axillary artery is divided into three stages by the lesser pectoral muscle. In its *first stage* the artery lies above that muscle, and is covered by the great pectoral and a dense fascia, (the costo-coracoid ligament), which stretches across the artery, as it passes from the cartilage of the first rib to be implanted into the under surface of the clavicle and coracoid process; it rests on the first layer of intercostal muscles and the second digitation of the serratus magnus. The brachial plexus lies behind it, and to its acromial side, the axillary vein anterior and internal to it.

The *second stage* of the axillary artery is that portion of the vessel which lies behind the pectoralis minor; it here crosses the axillary cavity, and is surrounded by cellular tissue and the brachial plexus of nerves, the median branch of which has the artery passing between its two heads. Here a number of veins, rather than one large vein, cover the artery lying in front and rather to the inner side, and it is covered by both pectoral muscles.

The *third stage* of the axillary artery extends from the lower edge of the pectoralis minor to the inferior edge of the latissimus dorsi and teres major tendons. Here the artery rests upon the insertion of the subscapularis muscle; and below this, on the tendons of the latissimus dorsi and teres major; a plexus of veins covers it, as in the second stage, and the branches of the brachial plexus are related to it as follows: to its *outer* side are the median and external cutaneous; to its *inner*, the internal cutaneous and ulnar; and *behind* it are the musculo-spiral and circumflex nerves. Sometimes the artery in this stage lies between the roots of the median nerve, one of which will then be on each side of the vessel. It is covered by the integuments and pectoralis major muscle, and may be exposed from the base of the axilla by cutting through the integuments and axillary fascia only.

The axillary artery may be tied in its first and third stages only, for the cure of aneurisms of the brachial artery, or in cases of wounds in these situations; the operation of tying the axillary artery in its first stage is performed as follows:

Place the patient in the recumbent posture; make a semilunar incision, concave upwards, through the integuments below the clavicle, and extending from near the sternal end of the clavicle, outwards towards the acromion process; the clavicular portion of the pectoralis major will thus be exposed, divide this, taking care to avoid the cephalic vein and the thoracica-acromialis artery; separate the edges of the wound, and the costo-clavicular ligament with the upper edge of the pectoralis minor will be brought into view; divide the former on a director, and depress the latter; tear through some cellular tissue and the artery will be exposed, having the vein anterior and internal to it, and the brachial plexus above and behind it: isolate the artery, and pass the aneurism-needle from within outwards.

We have no hesitation in stating that this operation should not be performed in preference to that of tying the subclavian artery in its third stage, It is both difficult and dangerous in performance, and not so likely, from the number of parts disturbed, to be as successful as the other. Some have advised the artery to be compressed here during the performance of amputation of the shoulder-joint. Surgeons have long abandoned this practice, preferring to apply pressure on the subclavian artery, where it crosses the first rib.

The axillary artery, in its third stage, may be tied very easily as follows: place the patient in the recumbent position, raise the arm from the side, make an incision in the line of the artery, about three inches in length, through the integuments and fascia, and opposite the head of the humerus, between the two folds of the axilla, but a little nearer the posterior one; tear cautiously through some cellular tissue, and the plexus of veins, with the branches of the brachial plexus of nerves, will be exposed, concealing the artery; carefully separate these parts, and isolate the vessel; pass the aneurism-needle from behind forwards. The median nerve is not unfrequently in front of the artery here, and some caution is therefore necessary in making our first incision. Bending of the elbow-joints, so as to relax the nerves, and permit of the more easy separation from the artery, will be found useful.

The branches of the axillary artery are as follows:

From its first stage	*Thoracica acromialis,* *........... suprema.*
.... second stage	*Arteriæ glandulares,* *Thoracica longa vel mammaria externa.*
.... third stage	*Subscapularis,* *Circumflexa, anterior et posterior.*

The *thoracica acromialis* is a short axis, of considerable size, which arises from the anterior part of the axillary artery; it immediately passes forwards above the superior edge of the pectoralis minor, and divides into numerous branches, which pass to the supply of the surrounding muscles, and anastomose externally with the circumflex, superior profunda, and suprascapular arteries, internally and inferiorly with the mammary and intercostal arteries; one branch, remarkable from its course, descends in the fissure between the pectoralis major and deltoid, in which the cephalic vein ascends; in general it lies behind the vein, at least at its upper part.

The *arteria thoracica suprema* is small, and runs inwards along the upper margin of the pectoralis minor muscle, to which and the pectoralis major it gives branches, anastomosing with the mammary and intercostal arteries.

The *arteriæ glandulares* are several small branches which sometimes arise by a common trunk (the *thoracica alaris*), and are distributed to the glands, cellular tissue, and muscular parietes of the axilla.

The *thoracica longa* vel *mammaria externa* is a large and regular branch which runs inwards, along the inferior margin of the pectoralis minor, under cover of the great pectoral muscle, to the parietes of the chest, the pectoral, serratus magnus, and intercostal muscles, the mammary gland, &c. It supplies these parts and anastomoses with the other thoracic, intercostal, and subscapular arteries.

In operating upon the axilla, extirpating the mammary gland, the course of this vessel should be attended to, for, if wounded, it pours out a large quantity of blood, as it becomes much increased in size in diseases attacking these parts.

The *arteria subscapularis* is generally the largest and most regular branch of the axillary, from the posterior and inner part of which it arises opposite the lower edge of the subscapularis muscle, concealed by some veins and branches of the brachial plexus of nerves. It runs downwards and backwards along the axillary border of the scapula, accompanied by the subscapular nerve and vein, and after a short course divides into two branches, anterior and posterior. The *anterior* branch, smaller, continues in the direction of the parent trunk, till it arrives at the inferior angle of the scapula, where it divides into several branches, which supply the teres major, latissimus dorsi, serratus magnus, and subscapularis muscles, and anastomoses with the terminating branches of the suprascapular and posterior scapular arteries. The *posterior* branch passes backwards, accompanied by a part of the nerve, through a triangular opening bounded in front by the long head of the triceps, below by the teres major, and above by the edge of the subscapularis, to which it sends branches, winds round the inferior costa of the scapula, and gains its dorsum, where it terminates in the infra-spinous fossa, by sending branches to the infra-spinatus muscle, and anastomoses with the terminating branches of the suprascapular artery. When operating in the axilla, this artery should be particularly avoided.

The free anastomosis of the vessels about the axilla, between the scapular, thoracic, intercostal, and mammary arteries, is of much service in restoring the circulation when the subclavian or axillary artery has been tied.

The *arteria circumflexa posterior* proceeds backwards from the axillary artery, close to the origin of the subscapularis artery, through a quadrilateral space, bounded *above* by the neck of the scapula, *below* by the teres major and latissimus dorsi muscles, in *front* by the neck of the humerus, and *behind* by the long head of the triceps; it then winds round the neck of the humerus, and is lost chiefly in the deltoid muscle, where it anastomoses with the anterior circumflex artery, and with branches from the superior profunda and superior scapular arteries. This artery is accompanied throughout, by the circumflex nerve, a branch of the brachial plexus.

In fracture of the neck of the humerus, and dislocation into the axilla, this artery may be ruptured, and may pour out a large quantity of blood into the axillary cavity. A portion of the coagula, passing between the broken ends of the bones in fractures, is said to have the effect of preventing their reunion. In these accidents the corresponding nerve is frequently injured, giving rise to a temporary or permanent paralysis of the deltoid muscle, varying according to the extent of the injury.

The *arteria circumflexa anterior* is smaller than the preceding, and frequently arises from it, or from the subscapular artery; it passes forwards and outwards, then winds round the anterior surface of the neck of the humerus, close to the bone, and behind the coraco-brachialis and biceps muscles, and terminates as the preceding artery. Two or three small branches proceed from it along the bicipital groove, to supply the synovial membrane of the shoulder-joint.

THE BRACHIAL REGION

Extends from the termination of the axilla to the elbow-joint, and comprises the greater part of the humerus, the brachial muscles, vessels, and nerves. On raising the integuments from off this region, some cellular tissue is brought into view, commonly called the superficial fascia. In it are contained some superficial veins and nerves; thus, on the outer side we find the cephalic vein, and on the inner side the basilic. The cephalic vein is unaccompanied in the arm by any nerve, but the basilic vein is attended by the nerves of Wrisberg, together with branches from the internal cutaneous and ulnar nerves. The *nerves of Wrisberg* are two in number; they arise from the second and third intercostal nerves, pass out through the corresponding intercostal spaces, cross the base of the axilla, and descend along the inner surface of the arm as far as the internal condyle. The *internal cutaneous* nerve perforates the brachial aponeurosis a little above the elbow-joint, and thence accompanies the basilic vein in the lower part of the arm, and throughout the forearm. The branch from the ulnar nerve, which becomes cutaneous in the arm, is known by the name of the cutaneous nerve of Soëmmering; it is lost about the internal condyle. Beneath these superficial parts, the muscles and deep-seated vessels and nerves of the arm are incased in a layer of fascia, named the brachial aponeurosis or fascia of the arm. This is much less dense than that which invests the forearm, and is in general but badly marked on the outer and posterior surface of the arm; internally, however, where it covers the brachial vessels and nerves, it is tolerably strong. It is attached superiorly and posteriorly to the spine of the scapula and infraspinatus muscles, from whence it descends, receiving an accession of fibres from the insertion of the deltoid muscle; internally it is continuous with the fascia, which forms the floor of the axilla, and is also attached to the tendons of the pectoralis major and latissimus dorsi muscles. As the brachial aponeurosis descends it becomes increased in strength, and serves to bind down the vessels, muscles, and nerves; towards the lower part of the arm it receives an addition of fibres from the coraco-brachialis muscle, and finally becomes implanted into the internal and external inter-muscular ligaments, by means of which it is connected to the condyles of the humerus.

On raising the brachial aponeurosis from the inner surface of the arm, and separating the biceps and triceps muscles, the brachial artery, veins, and nerves will be exposed, the artery being surrounded and partly concealed by the other parts.

THE BRACHIAL ARTERY,

the continuation of the axillary, commences at the lower margin of the teres major and latissimus dorsi muscles; passes downwards, forwards, and outwards, lying first on the inner surface of the arm, then on its anterior surface; descends below the joint of the elbow, where it sinks into a triangular fossa, and terminates, opposite the coronoid process of the ulnar, by dividing into the radial and ulnar arteries.

In this course it is comparatively superficial, being covered only by the integuments and fascia. In the middle of the arm it is a little overlapped, at least in strong muscular subjects, by the inner edge of the biceps muscle; at the bend of the elbow it is more deeply seated, and is covered by a strong aponeurosis (the *semilunar fascia*), derived from the tendon of the biceps muscle; it is here also a little overlapped by the pronator teres muscle.

In the superior part of the arm the brachial artery rests on the musculo-spiral nerve and the superior profunda artery, which separate it from the triceps muscle. In the middle third it rests on the tendon of the coraco-brachialis, and in the remainder of its course on the brachialis anticus muscle. In the first part of its course the brachial artery lies posterior to the coraco-brachialis muscle, between it and the triceps; but, as it descends, it gets in front of the former, and lies between the biceps and triceps. In the lower part of its course it is separated from the latter muscle by the internal inter-muscular ligament. Two venæ comites, one on either side, accompany the brachial artery, occasionally, also, the basilic vein runs in the course of the artery, but superficial to the fascia, as far as the axilla. The *median nerve* accompanies the brachial artery throughout; at first the nerve lies to its outer side, but as it descends it crosses the artery, passing in general superficial to, but sometimes behind it, and gets to its inner side. The *external cutaneous* nerve lies, for a short distance, to the outer side of the brachial artery near to its commencement, but soon parts from it to perforate the coraco-brachialis muscle. The *ulnar* nerve lies to the inner side of the brachial artery above, but, as it descends, it separates from the vessel, passing with the inferior profunda artery, behind the internal inter-muscular ligament and internal condyle. The *internal cutaneous* nerve, the *nerves of Wrisberg*, and the *cutaneous nerve* of Soëmmering descend parallel, but superficial, to the brachial artery.

The relations of the brachial artery at the bend of the elbow are of so much importance that we shall subjoin a distinct description and its relative anatomy here under the head of the

REGION OF THE ELBOW-JOINT.

Upon removing the integuments which cover the upper third of the forearm, on its anterior surface, several superficial veins and nerves are exposed contained in the superficial fascia. The *veins* are, on the *inner* side the *basilic*, on the *outer* side the *cephalic*, and *in the centre* the *median* vein with its two superficial branches, the *median-cephalic* and the *median-basilic*.

The *basilic* vein arises from the inner side of the hand and little finger; ascends along the ulnar or inner side of the forearm on its anterior surface; receives numerous branches from the front and back part of the forearm; passes upwards in front of the internal condyle, where it receives the median basilic vein; ascends along the inner surface of the arm, parallel, but superficial, to the brachial artery; and about the middle of the arm, but frequently above this point, and sometimes as high up as the axilla, perforates the brachial aponeurosis to join the venæ comites or axillary vein.

The *cephalic* vein commences about the thumb and back of the hand; ascends on the anterior surface of the forearm and along its radial side, receiving, as it passes upwards, several branches; then passes forwards in front of the external condyle, where it receives the median-cephalic vein; runs along the outer side of the biceps muscle, and finally, ascending in the groove, which separates the pectoralis major and deltoid muscles, it sinks into the triangular fossa below the clavicle and joins the axillary vein.

The *median* vein commences on the anterior surface of the wrist by means of small branches from the palm of the hand; ascends in the forearm, between the basilic and cephalic veins; and, at a short distance below the elbow, terminates by dividing into three branches, the median-cephalic, the median-basilic, and the deep median veins: of these the *median-basilic* ascends inwards, in front of the semilunar fascia of the biceps and the brachial artery to join the basilic vein; the *median-cephalic* ascends outwards to join the cephalic vein; and the deep median sinks deep and joins one of the venæ comites. These veins are accompanied by branches from the internal cutaneous and external cutaneous nerves.

When about to perform the operation of venesection, at the bend of the elbow, four veins present themselves, viz., the basilic, cephalic, median-basilic, and median-cephalic. Of these the median-basilic is most superficial, and would be selected but for its relation to the brachial artery, being only separated from this vessel by the semilunar fascia of the biceps. So great, therefore, is the risk of wounding the artery here, that the inexperienced practitioner at least should always prefer some other of the veins: of these the median-cephalic or basilic is to be preferred, the cephalic being objectionable on account of its rolling too freely beneath the point of the lancet.

On removing the superficial fascia, the *semilunar fascia* of the biceps and the fascia of the forearm are exposed. The former is derived from the anterior surface of the tendon of the biceps a little above the bend of the elbow, whence it descends inwards, taking a curved course towards the internal condyle, into which, and the fascia of the forearm, its fibres are implanted. The superior edge of this fascia is distinct, concave, seldom reaching as high as the level of the inner condyle, is directed upwards and inwards, and inferiorly is lost in the fascia of the forearm. This fascia then may be observed to cross the brachial artery, passing between it and the median-basilic vein, and hence serves as a partial protection to the artery, in venesection. From the resistance of this fascia, a circumscribed aneurism is generally formed at the bend of the elbow, when the brachial artery is wounded here. We may have, however, the other forms of aneurism consequent upon venesection, viz. diffused aneurism, aneurismal varix, and varicose aneurism.

Beneath the semilunar fascia of the biceps, the brachial artery sinks into a deep triangular fossa, situated immediately below and in front of the elbow-joint, bounded *above* by the brachialis anticus muscle, externally by the supinator radii longus, and *internally* by the pronator radii teres. The median nerve and biceps tendon accompany the artery into this fossa, the nerve lying to its inner, the tendon to its outer side.

Operations on the brachial artery. The brachial artery may be tied with facility in any part of its course. It is most frequently the subject of operation for the cure of aneurisms at the bend of the elbow, the result of careless venesection. Should the disease be a circumscribed aneurism, the artery may be tied in the middle of the arm; but if it be a diffused aneurism, the tumour should be cut into, the coagula be removed, and the artery tied above and below the orifice in its coats. Some recommend this operation to be performed for circumscribed aneurism also; or, at least, that the artery should be tied immediately above the tumour. Of the three proposed methods for the cure of circumscribed aneurism, the last is preferable, and is easiest of performance. Aneurismal varix and varicose aneurism seldom require an operation.

The brachial artery may be tied in the middle of the arm in the following manner: Place the patient in the recumbent posture, with the arm abducted and rotated outwards, make an incision, about three inches long, in a line with the inner edge of the biceps muscle, through the integuments and superficial fascia, taking care to avoid the superficial veins and nerves, cut through the brachial aponeurosis on a director, and proceed to separate the artery from the median nerve, and the venæ comites; this being accomplished, the artery is to be secured in the usual manner.

Before proceeding to the operation of tying the brachial artery at the bend of the elbow for the cure of aneurism, by cutting into the aneurismal tumour, and then securing the vessel above and below the wound in its coats, the circulation in the limb may be commanded by the tourniquet, applied at some distance above the elbow. This being done, an incision is to be made, about three inches in length, over the course of the artery, commencing it a little above the level of the internal condyle, and carrying it downwards and outwards. In this the integuments and superficial fascia are divided, and most probably some of the superficial veins, which should be avoided as much as possible. The semilunar fascia being now cut through, the aneurismal sac may be opened into; remove the coagula from its interior, and proceed to look for the artery, and particularly that part of it which has been wounded. This is sometimes a difficult task, in consequence of the presence of fibrinous coagula, which are matted together and conceal the artery, or even may be mistaken for the artery itself. Under these circumstances, the tourniquet should be slackened, when the blood will escape from the wound in the artery, and thus point out its situation. The artery being now separated from the surrounding parts, the aneurism needle armed with a double thread is to be passed beneath it; the needle being withdrawn, one thread is to be tied around the vessel above, the other below the wound in its coats, and the edges of the wound brought together in the usual way.

As the brachial artery frequently divides, high up in the arm, into the radial and ulnar arteries, it may happen that the operator, in performing either of the preceding operations, will meet with two vessels running parallel, or may possibly meet with but one, and that, perhaps, the vessel which does not require the ligature. This will point out to the surgeon the necessity of ascertaining, by compressing it between his fingers previously to tying the vessel, whether the vessel he is about to tie commands the circulation in the aneurismal tumour. Should it do so the artery may at once be tied, if not, another vessel exists which must be secured. It may be necessary to tie both vessels, as they not unfrequently communicate by means of a transverse branch in their course down the arm, which will render the tying of one vessel only perfectly useless.

The branches of the brachial artery are the superior profunda, the inferior profunda, and the anastomotica magna. The *arteria profunda superior* is the first and largest branch of the brachial, from the posterior part of which it arises, a little below the tendon of the teres major; then descends backwards and outwards, winds around the posterior surface of the humerus, between the second and third head of the triceps, and accompanied by the musculo-spiral nerve; and about the middle of the arm divides into two branches, an anterior and posterior.

The *posterior* branch, smaller, passes downwards and backwards through the substance of the triceps muscle to the outer and back part of the elbow, where it terminates in numerous branches, which anastomose in the substance of the anconæus, with the posterior recurrent interosseous artery, and with the other arteries about the elbow-joint.

The *anterior* or musculo-spiral branch descends with (but behind) the musculo-spiral nerve, in the groove on the anterior surface of the arm, between the supinator radii longus and extensor radialis muscles on the outer side, and the brachialis anticus on the inner side, as far as the elbow-joint, where it anastomoses with the radial recurrent artery.

In its course the superior profunda artery gives off several branches to the surrounding muscles; some of these ascend to the deltoid muscle to anastomose with the circumflex arteries, others descend in the triceps and brachialis anticus, and keep up an anastomosis with the various branches of the radial, ulnar, and interosseous recurrent arteries about the elbow-joint.

The *arteria profunda inferior* generally arises opposite the insertion of the coraco-brachialis muscle; runs downwards, backwards, and inwards, through the internal intermuscular ligament imbedded in the substance of the triceps muscle, and accompanied by the ulnar nerve, which lies to its inner side, or posterior to it, to the fossa between the internal condyle and olecranon process, where it terminates by anastomosing with the posterior ulnar recurrent arteries.

Arteria anastomotica magna arises in the lower third of the arm, descends along the anterior surface of the brachialis anticus to the elbow-joint, where it terminates by anastomosing with the anterior ulnar recurrent artery in front of the internal condyle, and with the anastomosis between the inferior profunda and the posterior ulnar recurrent arteries, between the internal condyle and olecranon process.

The brachial artery, besides the preceding, gives off the *arteria nutritia humeri*, which perforates the tendon of the coraco-brachialis, enters the substance of the humerus, descends obliquely, and supplies the cancelli and medullary membrane of the bone.

In amputation of the arm the situation of the branches of the brachial artery should be borne in mind, as they frequently require to be tied, especially where any disease of the elbow-joint has existed for some time previously, in which case all the arteries of the limb become much increased in size. The anastomoses around the elbow-joint, between the vessels of the arm and forearm, are so abundant as to restore the circulation to the latter part when the brachial artery has been secured : nay, even in some cases, it has been found so free as to interfere much with the success of the operation of tying the brachial artery in the middle of the arm for aneurism of this vessel at the bend of the elbow, and in many cases has rendered it completely useless.

THE ANTI-BRACHIAL REGION

Extends from the elbow to the wrist-joint, and comprises the anterior and posterior surfaces of the forearm.

Beneath the integuments on the anterior surface of this region we meet with the superficial veins and nerves described with the preceding. On raising these, the deeper seated parts are found to be invested by a layer of dense aponeurotic structure, the fascia of the forearm. This is weaker on the anterior than on the posterior surface of the forearm. Superiorly it is attached to the condyles of the humerus, and to the muscles which arise from these eminences; it is also attached to the biceps in front, the triceps behind; from these it descends and invests the muscles of the forearm, between which it sends in processes or septa, which divide them from one another, and afford to most of them points of origin. It is attached on either side to the radius and ulna, and inferiorly becomes connected with the annular ligaments of the wrist, the posterior of which appears to be formed altogether by it. The fibres of the fascia of the forearm run in different directions and interlace much.

This fascia is sometimes the seat of inflammation either idiopathic or symptomatic; it is attended with violent pain owing to the resistance of the fibrous structure of which it is composed. Should the inflammation not yield to the usual antiphlogistic remedies, the fascia should be divided by a free incision; the tension being thus removed the sufferings of the patient will be much lessened, and the inflammation will gradually subside. When matter has formed beneath the fascia the same plan of treatment becomes necessary.

On removing the fascia from the forearm, the muscles, vessels, and nerves of this region will be easily exposed by a very little further dissection. The principal vessels met with here are the radial, ulnar, and interosseous arteries. As the first of these is the most superficial, we shall first proceed to it.

ARTERIA RADIALIS.

We have already said that the brachial artery bifurcates opposite the coronoid process of the ulna into the radial and ulnar arteries. The former of these, although the smallest, runs more in the direction of the parent trunk.

From its origin the radial artery descends along the radial side of the forearm to the wrist nearly parallel with a line drawn from the centre of the elbow to the base or root of the metacarpal bone of the thumb, immediately above which it winds round the outer surface of the carpus, descends a little beneath the extensors of the thumb, turns forwards, passes between the heads of the first and second metacarpal bones, sinks deep into the palm of the hand, and then terminates near to the metacarpal bones in the deep palmar arch.

In the forearm the radial artery is superficial, being covered only by the integuments and fascia, except in its upper third, where it is overlapped by the convergence of the pronator teres and supinator longus muscles. It rests in the upper third of the forearm on the tendon of the biceps, and some fat, cellular tissue, and nerves, which separate it from the supinator brevis; in the middle third on the tendon of the pronator radii teres and the radial origin of the flexor sublimis; and in the inferior third on the flexor longus pollicis, and pronator quadratus, and on the extremity of the radius. To the outer side of the radial artery lies the supinator longus muscle; to its inner side the pronator radii teres, in the upper third of the forearm, but in the two lower thirds, the tendon of the flexor carpi radialis. The radial artery is accompanied only in its middle third by a nerve, viz., the musculo-spiral or radial nerve.

As the radial artery winds round the outside of the carpus it crosses the external lateral ligament of the wrist, then passes under the tendons of the extensor metacarpi and primi internodii pollicis, between which and the tendon of the extensor secundi internodii pollicis it may be felt during life; it finally descends beneath this tendon to the cleft between the first and second metacarpal bones.

The branches of the radial artery are the following:

Arteria radialis recurrens arises a little below the elbow-joint, winds outwards and upwards, and terminates in the fossa between the brachialis anticus and supinator longus, giving off branches which anastomose with the musculo-spiral artery.

From the origin of this artery to within an inch of the lower edge of the radius, the radial artery gives off only small branches to the neighbouring muscles. At this point it gives off the following branches :

Arteria superficialis volæ descends inwards over the anterior annular ligament to the root of the thumb, where it sends off several branches to the muscles of the thumb and surrounding integuments, and terminates by anastomosing with the superficial palmar arch.

Arteriæ carpi radiales, anterior and posterior, proceed from the radial artery, one on the anterior, the other on the posterior surface of the carpus, and pass to the carpal bones beneath the tendons, supplying the bones of the carpus and the synovial membrane of the wrist, and anastomosing with corresponding branches from the ulnar artery.

Arteriæ dorsales pollicis are two branches sometimes arising from one common trunk, which run along the lateral and dorsal surfaces of the thumb to its extremity.

While sunk in the cleft between the first and second metacarpal bones, the radial artery divides into its three terminating branches, namely, the arteria princeps pollicis, arteria radialis indicis, and the arteria radialis profunda.

Arteria princeps pollicis runs along the ulnar side of the metacarpal bone of the thumb, and at its extreme end divides into two branches, which run along the lateral surfaces of the phalanges of the thumb to its extremity, and there anastomose with each other, and with the preceding branches.

Arteria radialis indicis runs along the radial side of the index-finger to its extreme end, where it anastomoses with the branch on the ulnar side of the index-finger from the superficial palmar arch of arteries.

Arteria palmaris profunda runs in the hollow of the hand along the carpal extremities of the four metacarpal bones, and the interosseous muscles beneath the flexor tendons and lumbricales muscles, and opposite the fifth metacarpal bone anastomoses with the communicating branch from the ulnar artery, thus completing the deep palmar arch. From the convexity of this arch, where it is directed towards the fingers, several small branches pass to the interossei muscles; from its concavity branches ascend to anastomose with the carpal branches of the radial, and ulnar arteries. The deep palmar arch of arteries is accompanied by a corresponding arch of nerves, formed by the deep branch of the ulnar nerve. The nervous arch lies superficial to the arterial.

The radial artery is in general tied in consequence of its being wounded, or to restrain hemorrhage from the palmar arch when injured. It may be secured with facility in any part of the forearm by cutting through the integuments and fascia. In the middle and lower third the radial side of the flexor carpi radialis tendon guides us to the artery, but in the upper third we are to cut between the supinator longus and pronator teres muscles, which overlap the artery a little. As the musculo-spiral nerve lies to the outer side of the artery in its middle third, the aneurism needle should be passed from without inwards; elsewhere it is a matter of indifference what direction is given to the instrument.

ARTERIA ULNARIS.

From the division of the brachial the ulnar artery runs downwards and inwards along the ulnar side of the forearm, passing in front of the wrist between the two portions of the annular ligament, enters the palm of the hand, which it crosses beneath the integuments, and palmar fascia, obliquely forwards and outwards towards the metacarpal bone of the index-finger, where it terminates by anastomosing with the superficialis volæ and radialis indicis arteries. In the forearm the ulnar artery is deep, but becomes superficial in the palm of the hand. In the upper third of the forearm it is covered by the superficial layer of the flexors and pronators, namely, the pronator teres, flexor carpi radialis, palmaris longus, and the flexor digitorum sublimis; in the two lower thirds, it is covered only by the integuments, the fascia of the forearm, and the tendon of the flexor carpi ulnaris.

At first the ulnar artery rests on the brachialis anticus, but throughout the rest of the forearm on the flexor digitorum profundus. It is joined at the junction of the upper and middle thirds of the forearm by the ulnar nerve, which accompanies it to the palm of the hand; the nerve lies to the inner or ulnar side of the artery, except at the wrist, where it inclines towards its posterior surface. The median nerve accompanies it for a short distance after its origin, but, perforating the pronator teres, is separated from the artery by the second head of that muscle; the nerve again joins the ulnar artery in the palm of the hand, where it forms the superficial palmar arch of nerves.

The principal branches of the ulnar artery are the following:

1 and 2. *Arteriæ recurrentes anterior and posterior*, arise

sometimes together, sometimes separately, from the artery a short distance below the elbow-joint. The anterior, the smaller of the two, ascends beneath the pronator teres on the anterior surface of the brachialis anticus, where it terminates by supplying the neighbouring muscles, and anastomosing, with the anastomotica magna, and inferior profunda arteries. The posterior ulnar recurrent artery ascends to the fossa between the internal condyle and olecranon process, where it lies with and beneath the ulnar nerve, between the two heads of the flexor carpi ulnaris; it supplies the elbow-joint and triceps muscle, and anastomoses with the inferior profunda and anastomotica magna arteries.

A short distance below the preceding the ulnar artery gives off the *arteria interossea:* this vessel, of considerable size, passes backwards, downwards, and outwards, to arrive at the interosseous membrane; it gives off a few branches, the *anterior recurrent* arteries, which ascend in front of the elbow-joint, and anastomose with the other arteries in this situation. At the upper extremity of the interosseous membrane, the interosseous artery divides into two branches, named the anterior and posterior interosseous.

The *anterior* branch descends along the anterior surface of the interosseous membrane, between the flexor pollicis longus and flexor digitorum profundus, accompanied by a branch of the median nerve, to the upper edge of the pronator quadratus, where it divides into two branches, one of which descends in the substance of the muscle in front of the wrist into the palm of the hand, where it anastomoses with the anterior carpal arteries, and the deep palmar arch; the other branch passes backwards through the interosseous membrane to the back of the wrist and hand, where it anastomoses with the posterior carpal and interosseous arteries. The *posterior* interosseous artery passes between the anterior oblique ligament and the upper edge of the interosseous membrane to the back of the forearm, where, between the superficial and deep layers of muscles, it divides into two branches, one of which, the posterior interosseous recurrent, ascends in the substance of the anconæus to the fossa between the internal condyle and olecranon process, where it anastomoses with branches from the superior and inferior profunda arteries. The other branch descends amongst the extensor tendons to the wrist, where it anastomoses with the posterior carpal arteries, and with the posterior branch of the anterior interosseous artery.

As the ulnar artery descends in the forearm to the wrist, it gives off only muscular branches, until it arrives near the wrist where we have proceeding from it, the

Arteriæ carpi ulnares, anterior and posterior: these correspond with the branches given off by the radial artery, with which and the interosseous arteries they anastomose freely around the articulation.

Opposite the base of the fifth metacarpal bone, the ulnar artery divides into its two terminating branches.

Arteria communicans vel *profunda* sinks deep into the palm of the hand, accompanied by a branch of the ulnar nerve to join and complete the deep palmar arch of arteries.

Arteria palmaris superficialis runs obliquely forwards and inwards across the palm of the hand to the centre of the second metacarpal bone, where it turns upwards to join the superficialis volæ artery, and a branch from the radial artery, thus completing the *superficial palmar arch.* This is much better marked than the deep palmar arch, lies nearer the fingers, and crosses the hand more obliquely; its convexity is directed forwards and inwards towards the little and ring fingers, and gives off four digital arteries: the first of these supplies the ulnar side of the little finger; of the remaining three, each divides opposite the cleft between the fingers into two branches, which run along the opposed sides of the little, ring, middle, and index fingers, respectively, and terminate in the pulp of the finger by anastomosing with the opposite artery.

The superficial palmar arch of arteries is accompanied by an arch of nerves derived from the median, and a small branch from the ulnar nerve. The arch of nerves lies deeper than the arch of arteries. Opposite the cleft between the fingers each artery perforates its accompanying nerve. On the sides of the fingers the nerves lie superficial to the arteries; the nerves like the arteries terminate in the pulp of the fingers, which are thus endowed with a very high degree of organization, and which enables them to execute the function of touch more perfectly than any other part of the body. From the concavity of the palmar arch of arteries small branches pass upwards to anastomose with the carpal and interosseous arteries.

The fingers are supplied with arteries and nerves as follows: The ulnar artery supplies the ulnar side of the little finger, and the opposed sides of the little, ring, middle, and index fingers; the radial artery supplies the radial side of the thumb, and the opposed sides of the thumb and index fingers. The median nerve supplies the radial side of the thumb, and the opposed sides of the thumb, index, middle, and ring fingers; the ulnar nerve supplies the ulnar side of the little finger, and the opposed sides of the little and ring fingers. On the back of the hand the posterior branches of the musculo-spiral and ulnar nerves supply respectively two fingers and a half; the former, the thumb, the index, and one half of the middle finger; the latter the remaining fingers.

The surgeon is very frequently called on to tie the ulnar artery in consequence of wounds of the palmar arch of arteries. We have already said that the palm of the hand is one of the situations, the sole of the foot being the other, in which wounds of the contained arteries are treated by tying the artery leading to the injured vessels, contrary to the general practice of cutting down on the wounded artery, and securing it above and below the wound. The cause of this deviation from the general practice in these instances will be found in the number of vessels, nerves, and tendons in both the palm of the hand and sole of the foot the disturbance and unavoidable injury of which in looking for the injured vessel would more than counterbalance the advantage that might be derived from tying the artery where injured. When, therefore, the superficial palmar arch of arteries has been wounded, and that compression by means of portions of lint or sponge has been found ineffectual in restraining the hemorrhage, the ulnar artery should be tied in the lower third of the forearm. In some cases, this operation, although followed by the use of compresses in the palm of the hand, has been found insufficient to restrain the bleeding in consequence of the free communication that exists between the superficial and deep palmar arches of arteries; hence it may be necessary to tie also the radial artery. The ulnar artery is also tied occasionally for the cure of aneurism; but, as this disease rarely affects arteries of such a size, it is seldom that the operation is required for this particular purpose.

The ulnar artery may be tied with facility in either the middle or lower third of the forearm, by making an incision, about two inches and a half in length, through the integuments and fascia over the course of the artery, along the radial side of the flexor carpi ulnaris tendon. On separating the edges of the wound it will be found necessary to cut through a thin layer of fascia, which binds down the tendon; this having been done, the tendon is to be raised, when the artery is at once brought into view; having been sufficiently detached from the ulnar nerve, which lies to its ulnar side, and its two venæ comites, the aneurism needle is to be passed from within outwards, and the artery thus secured. Much difficulty, however, will be experienced in any attempt to tie this vessel in the upper third of the forearm, as it here lies covered by the superficial layer of flexor and pronator muscles. Mr. Guthrie has recommended us to cut through the bellies of these muscles directly down upon the vessel; others advocate the making our incision on the inner side of the forearm, parallel to and a little in front of the ulna, when, by passing between the two layers of muscles, the artery may be secured without much further difficulty; the ulnar nerve will first be exposed in this operation, and will thus serve as a guide to the artery.

The depth of the interosseous artery nearly precludes it from any interference on the part of the surgeon. The radial, ulnar, and interosseous arteries will require to be tied in amputations of the forearm.

We shall now proceed to the consideration of the muscles of the anti-brachial region or forearm. The muscles of this region are divided, according to their uses, into two sets, namely, pronators and flexors, supinators and extensors. The flexors are so named from their flexing the elbow or wrist joint, or the fingers; the pronators from their causing the radius to roll on the ulna, so as to pronate the hand, that is, to place the palm of the hand downwards; in general, both these modes of action are possessed by each muscle. This set of muscles arise chiefly from the internal condyle, and the inner or ulnar side of the forearm, and lie on its anterior surface. The extensors extend the elbow or wrist joint or fingers; the supinators roll the radius backwards, so as to supinate the hand, or place it with the palm looking upwards. These muscles arise chiefly from the external condyle, and lie on the posterior and outer surface of the forearm.

The *pronator and flexor* muscles, eight in number, are divided into a superficial and deep layer by the ulnar artery and the median and ulnar nerves; the *superficial* layer comprises five muscles, viz.

The pronator radii teres,
Flexor carpi radialis,
Palmaris longus,
Flexor carpi ulnaris,
Flexor digitorum sublimis.

The deep layer consists of but three muscles, viz.

Flexor digitorum profundus,
Flexor longus pollicis,
Pronator radii quadratus.

The origin and insertion of these muscles are given in a former part of this work.

The tendons of the two flexors of the fingers and long flexor of the thumb, together with the median nerve and the flexor carpi radialis tendon, pass beneath the anterior annular ligament of the wrist, and are invested at this part with a large synovial sheath, which ascends into the forearm, and descends towards the palm of the hand to some distance, terminating at each extremity in a cul-de-sac. This sac being constantly filled with synovial fluid, lubricates the tendons, and thus facilitates their free motions.

In injuries about the wrist, effusion of serum frequently takes place into this bursa, which becoming distended causes much deformity, and is frequently mistaken for a dislocation of the radius or ulna, or both bones. Wounds of this bursa are followed by a severe erysipelatous inflammation of the forearm: the same is the result of inflammation in the palm of the hand, when the inflammation, not being subdued by appropriate treatment, ascends into the forearm. The flexor tendons are bound to the phalanges by a strong fibrous sheath, which, with the bone beneath, forms a canal for their transmission, lined by a synovial sac. The fibrous sheath is less distinct opposite the articulations, and is continuous anteriorly with the tendons of the deep flexors.

PALMAR REGION, OR PALM OF THE HAND.

In the preceding description, the vessels and nerves and principal tendons in the palm of the hand have been treated; we shall not recapitulate them, but describe only the other parts which are most important in this region.

On raising the integuments, a few muscular fibres are exposed on its inner and anterior part, and constitute the *palmaris brevis* muscle.

By a little further dissection, the palmar aponeurosis or fascia will be brought into view. This is a dense layer of fibrous structure, which covers the vessels and nerves in the centre of this region, sending off, at the same time, other layers on either side to cover the muscles of the thumb and little finger. This palmar fascia is triangular in shape; its apex, posteriorly, is attached to the annular ligament and the tendon of the palmaris longus; from this it descends, expanding, and, after a short course, divides into four distinct portions, each of which subdivides into two processes, which pass forwards and are inserted, one on each side, into the lateral ligaments of the metacarpo-phalangeal articulations and the sheaths of the flexor tendons, leaving intervals for the passage of the tendons, nerves, and vessels, to the fingers. The fibres of the palmar aponeurosis are chiefly longitudinal, but towards its anterior parts some transverse ones may be noticed, which bind the longitudinal fibres firmly together; other fibres sink deep from the fascia into the palm of the hand, and become attached to the metacarpal bones and interossei muscles. The palmar aponeurosis binds down the veins, nerves, and tendons of the palm of the hand, and protects them from injury.

In a practical point of view it is of much importance. In cases of wounds of the arteries in the palm of the hand, the resistance of this fascia prevents the employment of compression from being as useful as it would otherwise be in restraining the hemorrhage; hence surgeons are frequently obliged to tie one or both of the arteries of the forearm before the bleeding can be sufficiently controlled. When abscesses, too, form beneath the palmar fascia, as frequently occurs in cases of paronychia, wounds in dissection, &c., it is necessary to give the matter a free and early exit; if this be neglected, the inflammation will spread upwards, beneath the annular ligament, into the forearm, and thus implicating the tendons and their synovial sheath, will give rise to much local and constitutional disturbance. There need be little apprehension, in opening these abscesses, of wounding the palmar arteries, as the matter almost always lies immediately beneath the fascia, and will flow out as soon as this has been divided. Occasionally the matter points in the cleft between the fingers, owing to the less resistance of the fascia in these situations; in such cases, the introduction of the point of the lancet into the swelling, will give exit to the matter and relieve the patient.

Beneath the palmar aponeurosis the superficial arches of arteries and nerves cross the palm of the hand; the first formed chiefly by the ulnar artery, the nervous arch chiefly by the median nerve. The arteries lie superficial to the nerves. On raising them, the muscles of the thumb are exposed on the outer side, the long tendons and lumbricales in the centre; and beneath them, the deep arches of arteries and nerves and the interossei muscles, and internally, the muscles of the little finger. The particulars connected with these have been adverted to in other parts of the work to such an extent, as not to require any further lengthened description.

ARTERIÆ ILIACÆ COMMUNES.

The aorta bifurcates in front, and a little to the left side, of the fourth lumbar vertebra, sometimes the third or fifth, and opposite to a point, corresponding externally to a little below and to the left side of the umbilicus, into the right and left common iliac arteries. Each common iliac artery thence descends outwards, and opposite the sacro-iliac symphysis, divides into the internal and external iliac arteries. The common iliac arteries are covered in front by the peritoneum, and are crossed at their bifurcation by the ureters; on the left side, by the colon descending to form the rectum, and on the right by the ileum terminating in the cæcum. The right common iliac artery crosses the last lumbar vertebra, with the intervention of the left common iliac vein, and the commencement of the vena cava, which is formed behind the artery by the junction of the two common iliac veins; it then crosses its own vein, which lies superiorly to its outer but inferiorly to its inner side. The left common iliac vein lies, throughout, internal and posterior to its artery. There is no regular difference in the lengths of these two vessels, as is generally stated. From the angle of bifurcation of the aorta there proceeds the

Arteria sacri media. This is a small vessel which descends in front of the mesial line of the sacrum to the coccyx, sending off branches on each side to communicate with the lateral sacral arteries, and others in front to the rectum.

The common iliac artery is tied, in aneurisms of the external iliac, high up, of the internal iliac artery, or of its principal branches. The operation is performed by making a slightly curved incision from four to five inches in length in the lateral part of the abdominal parietes, extending one half above, the other below, the anterior superior spinous process of the ilium. The integuments and muscles having been cut through, the transversalis fascia is to be carefully divided, and the peritoneum drawn upwards and inwards towards the umbilicus. The common iliac artery may be now easily felt, or even seen, when the aneurism needle should be passed from within outwards, except in tying the artery on the right side, in the lower part of its course, when the contrary direction is to be preferred, and the vessel secured.

Arteria iliaca interna vel *hypogastrica* proceeds from the bifurcation of the common iliac artery downwards and backwards, in the posterior part of the pelvis, in front of the sacro-iliac symphysis, as far as the upper part of the great sciatic notch, where it terminates by dividing into two or three large branches. In this course, the internal iliac artery has to its inner side and posteriorly the origins of the pyriformis muscle and the anterior sacral nerves; behind it is the lumbo-sacral nerve, and in front of it the peritoneum. The internal iliac vein and the branches which are about to form it generally cover the internal iliac artery so as to obscure it from view. In the adult, this artery is somewhat smaller than the external iliac, but in the fœtus it appears as the continuation of the common iliac, both as to size and direction; at this period of life, it returns the blood from the fœtus to the placenta of the mother; its principal branch then forms the umbilical artery, which ascends along the lateral surface of the bladder, behind the rectus muscle to the umbilicus, where it passes out and forms, with the artery of the opposite side and the umbilical vein, the umbilical chord. After birth, when the chord is tied the blood ceases to circulate in the umbilical artery, which becomes obliterated from the umbilicus to the bladder; it thus diminishes in size, and forms one of the vesical arteries in the adult.

The internal iliac artery may be tied for aneurism of one of its principal branches. This operation may be performed, like that for tying the common iliac artery, the incisions being made somewhat lower down. In securing these vessels the ureter is not endangered, as it follows the peritoneum when this membrane is raised out of the iliac fossa. We consider it is better to secure the common iliac artery, than resort to the operation of tying the internal iliac, as this is a much more difficult operation, and not so likely to succeed, from the number of important parts disturbed, and the shortness of the arterial trunk.

The *branches* of the internal iliac artery are divided into the *internal* and *external*. The internal are small, and are distributed to the walls of the pelvis and its contents; the external are large, pass out of the pelvis, and are lost in the external soft parts.

The *internal* branches are the ilio-lumbar, lateral sacral, middle hemorrhoidal, vesical; and in addition, in the female, the vaginal and uterine arteries.

1. *Arteria ilio-lumbalis* arises from the external and posterior part of the internal iliac artery, runs upwards and outwards, in front of the lumbo-sacral nerve, and behind the common iliac artery and vein, psoas and iliacus internus muscle, and anterior crural nerve, to the iliac fossa, where it terminates in numerous branches, some of which ascend to the psoas and quadratus lumborum muscles, and anastomose with the lumbar branches of the aorta, whilst others pass outwards to the crest of the ilium, and anastomose with the branches of the interna circumflexa ilii and gluteal arteries. A branch of the ilio-lumbar artery enters a foramen of the inner surface of the os ilium, and supplies the bone.

2. *Arteria sacri lateralis* passes from the inner side of the internal iliac artery downwards and inwards, in front of the pyriform muscle and sacral nerves, and to the outer side of the sympathetic nerve, and terminates in supplying branches to the sacral nerves in the interior of the sacrum

and the pyriform muscle, and in anastomosing with the branches of the middle sacral artery near the coccyx.

3. *Arteria hæmorrhoidalis media* passes downwards, forwards, and inwards, along the posterior and lateral surface of the rectum, on which it is lost, anastomosing superiorly with the branches of the superior hemorrhoidal artery from the inferior mesenteric, and inferiorly with the inferior or external hemorrhoidal branches of the internal pudic. The rectum thus receives a supply of blood from three sources, the inferior mesenteric, the internal iliac and the internal pudic; the largest branches of these hemorrhoidal arteries are met with on the posterior surface of the rectum, but these soon break down and surround the intestine, as far as the anus, with numerous vascular ramifications, some of which, inferiorly, pass forwards to the bladder, prostate gland, and vesiculæ seminales, in the male, the vagina in the female.

In the operations for fistula in ano, piles, &c. some of these branches are in general wounded; if large, serious hemorrhage may be the result. Under these circumstances, the surgeon should, if the application of cold or pressure to the part be insufficient to restrain the bleeding, at once look for and secure the bleeding vessel with the tenaculum, if this can be effected; where such is impossible, the rectum should be plugged. As the vessel may bleed into the rectum, and so escape observation, until so much blood has been lost as to prove fatal to the patient, the practitioner should always be on his guard after the performance of these operations.

4. *Arteriæ vesicales*, irregular as to origin, size, and number, proceed to the inferior fundus of the bladder, where they are principally lost. The fœtal umbilical artery forms one of the vesical arteries in the adult.

5. *Arteria vaginalis* runs along the anterior and lateral part of the vagina and supplies it with branches, as also the bladder and rectum, anastomosing with branches of the pudic artery.

6. *Arteria uterina* passes forwards and inwards, runs between the laminæ of the broad ligament of the uterus, which it supplies, sending some branches to the ovary and Fallopian tube. During pregnancy the uterine arteries become much enlarged and tortuous.

The *external* branches of the internal iliac are the obturator, gluteal, sciatic, and internal pudic.

1. *Arteria obturatoria* vel *thyroidea* runs downwards and forwards in the cavity of the pelvis, below and internal to the external iliac artery and vein, and accompanied by the obturator nerve, which lies in front of it, passes out through the upper part of the obturator foramen into the superior and inner part of the thigh, where it divides into numerous branches, which supply the obturator and adductor muscles, and anastomose with the branches of the internal circumflex artery. The obturator artery generally sends off a branch which enters the hip-joint through the notch in the inner part of the acetabulum, runs along the ligamentum teres, and supplies the head of the femur. The obturator artery frequently arises from the epigastric, whence, crossing the femoral ring, it enters the obturator foramen. When it takes this course it may pass either to the inner or outer side of the neck of the sac of a femoral hernia; when such exists, fortunately, it generally takes the latter course, and is thus seldom endangered in the operation for strangulated femoral hernia.

2. *Arteria glutea*, the largest branch of the internal iliac artery, runs downwards, backwards, and outwards, through the upper part of the great sciatic notch, above the pyriform muscle, and accompanied by the superior gluteal nerve to the supply of the gluteal muscles, in which its branches anastomose, superiorly with those of the internal circumflex iliac artery, inferiorly with branches of the sciatic, anteriorly with those of the external circumflex, and posteriorly with branches of the internal pudic artery.

The gluteal artery has been twice cut down upon, and tied where it escapes from the great sciatic notch, in cases of wounds by penetrating instruments. This operation may be performed by making an incision from the posterior spinous process of the ilium to the great trochanter, the artery lying at the junction of the posterior with the middle third of this line; the skin and fascia having been cut through, the incision should be extended between the fibres of the gluteus maximus, on separating which, and tearing through some cellular tissue, the gluteal artery may be felt by pressing the finger against the upper part of the great sciatic notch, where the vessel lies between the pyriformis and gluteus medius muscles. The gluteal artery may be affected with aneurism; here, the internal iliac or the common iliac artery should be secured.

3. *Arteria ischiatica* vel *sciatica* runs a short distance in the pelvis; passes out through the great sciatic notch, below the pyriform muscle, along with, but above, the great and lesser sciatic nerves and pudic artery; descends on the outer side of the pelvis with the great sciatic nerve, between the tuber ischii and great trochanter, but nearer the former, and terminates in some branches which supply the surrounding muscles; some of these ascend to anastomose with the gluteal and pudic arteries; others descend to the muscles on the back of the thigh, and anastomose with the branches of the internal circumflex and perforating arteries. The only important branch of the sciatic artery is one which accompanies the sciatic nerve; this branch is found to be much enlarged in cases where the femoral or iliac artery has been tied. The sciatic artery may be exposed and tied by an incision, similar to that recommended for securing the gluteal artery, but an inch and a half lower down.

Arteria pudica interna proceeds in company with the sciatic artery out of the pelvis; winds round the spine of the ischium, and insertion of the lesser sciatic ligament; re-enters the pelvis through the lesser sciatic notch, runs upwards and forwards on the inner surface of the tuber ischii and ramus of the ischium and pubes, until it arrives at the sub-pubic ligament, when it terminates by dividing into the artery of the corpus cavernosum and the dorsal artery of the penis. In this course, the pudic artery is accompanied by the pudic nerve, a branch of the sacral plexus. In the first part of its course, the pudic artery gives off a few small branches to the bladder and vesiculæ seminales in the male, to the vagina and uterus in the female. Whilst external to the pelvis, or in its second stage, the pudic artery gives off a few branches to the surrounding muscles. In its third stage the pudic artery is bound to the inner surface of the bones and the obturator muscle by the obturator fascia and an expansion from the great sciatic ligament, and lies along the outer side of the perineum, where it is endangered in performing the operation of lithotomy. The principal branches arise from the pudic artery in this stage of its course, and are as follows:

1. *Arteriæ hæmorrhoidales externæ* are two or three in number: they are distributed to the lower extremity of the rectum, where they anastomose with the other hemorrhoidal arteries.

2. *Arteria perinæi* pierces the obturator fascia and base of the triangular ligament, runs forwards and inwards in the interspace between the accelerator urinæ and erector penis, and is lost in the integuments of the perinæum and scrotum. This artery runs in the line of our incisions in the operation of lithotomy, and therefore cannot be avoided.

3. *Arteria transversalis perinæi* runs forwards and inwards along the anterior and cutaneous surface of the transversus perinæi muscle to the mesial line, where it terminates by anastomosing with its fellow of the opposite side. This artery is cut across in the operation of lithotomy.

4. *Arteria corporis bulbosi* vel *spongiosi urethræ* arises opposite the crus penis; runs inwards and slightly forwards, between the layers of the triangular ligament; enters the bulb, and supplies the corpus spongiosum urethræ. This artery is much endangered in the operation of lithotomy, and should be avoided. Sir A. Cooper mentions a case of hemorrhage from the urethra, in which he cut down and divided this artery, to arrest the bleeding, with success.

5. *Arteria corporis cavernosi penis.* At the ramus of the pubes the pudic artery perforates the triangular ligament and runs between the bone and the crus penis; it here divides into the artery of the cavernous body and the dorsal artery of the penis. The former perforates the crus penis, runs forwards in the corpus cavernosum, close to the septum pectiniforme, and terminates by supplying the erectile tissue of that body, and anastomosing with its fellow of the opposite side through the septum.

6. *Arteria dorsalis penis* ascends between the ramus of the pubes and crus penis, joins the dorsal veins and nerves of the penis, runs between the fibres of the suspensory ligament, and then passes forwards in the groove on the dorsum of the penis, beneath the skin and superficial fascia, as far as the corona glandis, in which and the prepuce it is lost.

In cases of hemorrhage from the penis, arising from sloughing ulcers, ruptured urethra, or other causes, it may be necessary to tie the dorsal artery; this is easily done by making an incision on the dorsum of the penis, in the course of the artery. Hemorrhage from the urethra may be restrained by passing a silver catheter into the canal, and then applying a bandage tightly round the penis. In more urgent cases, Sir A. Cooper's practice may be followed, or the pudic artery be compressed, where it crosses the spine of the ischium. The dorsal artery of the penis sometimes arises, as a distinct branch from the internal iliac artery, whence it passes directly forwards, along the lateral surface of the neck of the bladder and prostate gland, to its destination; should the operation of lithotomy be performed in a subject where this variety exists, it would be almost impossible to avoid wounding the artery. In amputations of the penis, the dorsal arteries and the arteries of the corpora cavernosa are usually tied; there is some difficulty in securing the latter, from their retracting into the cells of the cavernous body; where they cannot be tied, pressure should be applied on the part by means of a dossil of lint.

The pudic artery has an analogous course and distribution in the female to the male; its terminating branches are lost in the body and on the dorsum of the clitoris. It is much smaller in the female. The pudic artery is small before the age of puberty.

The trunk of the pudic artery may be tied in its second stage by an operation similar to that recommended for securing the sciatic artery; our object should be to expose the spine of the ischium, where the artery will be found without fail.

ARTERIÆ ILIACÆ EXTERNÆ.

The external iliac artery on each side proceeds from the bifurcation of the common iliac, downwards and outwards, along the inner margin of the psoas muscle and brim of the pelvis, as far as Poupart's ligament; it passes beneath this igament a little to the pubic side of its central point, and enters the thigh, when it assumes the name of femoral artery. In this course, the external iliac artery is covered by the abdominal muscles and peritoneum, and by a thin layer of fascia, named the "fascia propria" of the external iliac artery, derived from the fascia iliaca, having to its inner side, and a little behind it, the external iliac vein; to its outer side, and in close contact with it, the genito-crural nerve; and still more externally, the anterior crural nerve lying imbedded between the psoas and iliacus internus muscles.

The external iliac artery gives off a few small branches to the surrounding muscles and cellular tissue, and about half an inch above Poupart's ligament, the two following important vessels.

1. *Arteria epigastrica* proceeds from the inner side of the external iliac artery, first downwards and inwards, then turns upwards and inwards, winding round the cul-de-sac of the peritoneum, ascends in the transversalis fascia, enters the sheath of the rectus muscle, and here terminates in numerous branches, which supply this muscle and anastomose with the branches of the internal mammary artery. Soon after the epigastric artery begins to ascend, it crosses to the inner side of the internal abdominal ring, lying behind the spermatic chord; it is here hooked round by the vas deferens, which then descends, internal and posterior to it, into the pelvis; here the artery gives off several branches to the spermatic chord and abdominal muscles; one considerable branch, the artery of the vas deferens, descends on the chord which it supplies.

On account of the relation of the epigastric artery to the abdominal rings, between which it lies, we should divide the stricture, in oblique inguinal hernia, upwards and outwards, but in the direct species upwards and inwards; and when we are in doubt as to the form of the hernia, directly upwards. This vessel may be wounded in the operation of tapping an ovarian cyst, or of paracentesis abdominis, according to the old method.

2. *Arteria circumflexa ilii* runs upwards and outwards from the outer side of the external iliac artery beneath the tendinous white line, formed by the junction of the trans-

versalis fascia and fascia iliaca, to the anterior superior spinous process of the ilium; it then winds round the inner edge of the crest of the ilium, between the internal oblique and transversalis muscles, in which it terminates, by sending off numerous branches which supply the abdominal muscles, and anastomose with the branches of the lumbar, ilio-lumbar, and gluteal arteries.

The external iliac artery is tied in cases of femoral aneurism high up, or of hemorrhage from the femoral artery, after it has been tied for the cure of popliteal aneurism. It may be also secured, according to the distal operation, for the cure of an aneurism of its cardiac extremity. There are two operations performed for this purpose, one recommended by Mr. Abernethy, the other by Sir A. Cooper. Mr. Abernethy's operation is performed as follows.

Make an incision, four inches in length, over the course of the artery; this will be nearly perpendicular to the centre of Poupart's ligament, the skin, fascia, and external oblique having been cut through, a director is to be passed beneath the lower edge of the internal oblique and transversalis muscles, and these then may be divided; the transversalis fascia being now cut through, the peritoneum is to be raised inwards, out of the iliac fossa, when the artery is exposed: the fascia propria being now carefully divided, the aneurism needle is to be passed from within outwards, avoiding the genito-crural nerve, and the vessel secured at some distance above the origins of the epigastric and circumflexa ilii arteries.

In Sir A. Cooper's operation, a semilunar incision is made, about four inches in length, having its concavity directed upwards and inwards towards the umbilicus, and extending from a little above and internal to the anterior superior spinous process of the ilium, to the outer side of the external abdominal ring; by this, the skin, fascia, and external oblique tendon are divided, the inguinal canal is now exposed and the lower edge of the internal oblique and transversalis raised upwards; the internal abdominal ring being now brought into view is dilated, and the finger passed through it to the artery, which is tied, as in Mr. Abernethy's operation.

Of these two operations Sir A. Cooper's is to be preferred, as it is more easily performed, and the abdominal muscles are not divided to the same extent; hence a hernia is not so likely to succeed; in addition, should secondary hemorrhage ensue, we can have recourse to Mr. Abernethy's plan, and tie the vessel higher up.

THE PERINEUM IN THE MALE.

The *perineum* is a diamond-shaped space, situated between the upper part of the thighs, bounded in front by the scrotum, behind by the coccyx, on each side by the ramus of the ischium and pubes, the tuber ischii, the great sciatic ligament, and inferior border of the gluteus maximus muscle. The integuments covering the perineum are thin and of a brownish colour. On the mesial line a ridge projects, named the *raphe* of the perineum, which commences in front of the anus, extends forwards along the perineum, scrotum, and under surface of the penis, in some subjects as far as the frænum preputii. As the raphe indicates the mesial line, it serves as our guide in cutting down on the urethra, opening abscesses in perineo, &c.; in the operation of lithotomy, we cut to its left side.

On raising the integuments from the perineum, the *superficial fascia* and sphincter ani are exposed. The superficial fascia is thin and loose; it is continuous with the surrounding cellular tissue, and contains a few small blood-vessels and nerves; posteriorly, it becomes increased in quantity, and loaded with adipose tissue, and sinks into a deep triangular fossa between the rectum and levator ani internally, and the obturator internus muscle externally. This adipose tissue is sometimes attacked with erysipelatous inflammation, which if not restrained may terminate in sloughing, so as to lay bare the rectum. Incisions should be made into the cellular tissue, before the inflammation arrives at its height.

The *sphincter ani* muscle is seen to surround the lower extremity of the rectum, and thus closes the anus, except during the expulsion of the fæces. In the operation of lithotomy, a few of the lateral fibres of this muscle, if well developed, are cut across. The operation for the cure of fistula in ano consists in dividing the sphincter ani muscle, in cutting through the fistula, as the contraction of the muscular fibres is the chief impediment to the healing of the sinus. Dupuytren recommends the division of the muscle, for the relief of those painful fissures, which occasionally form in the margin of the anus. The *deep sphincter ani* lies above the preceding, and encircles the lower extremity of the rectum; it is formed by the muscular fibres of the intestine and those of the levator ani, which here take a circular course.

On removing the superficial fascia, the *perineal fascia* is brought into view: this is a dense layer of fascia, which invests the muscles of the perineum; on each side it is firmly attached to the ramus of the ischium and pubes; anteriorly, it is continuous with the fascia of the scrotum, posteriorly it is lost on the anterior surface of the rectum, where it becomes continuous with the posterior edge or base of the triangular ligament. When extravasation of urine takes place into the perineum, from rupture of the urethra, the attachments of the fascia prevent the fluid from passing either laterally or posteriorly; consequently it is forced forwards into the cellular tissue of the scrotum, whence it ascends on the abdominal parietes. In making our incisions in perineo to allow of the escape of the fluid, the perineal fascia should be freely divided. When abscesses form in perineo the resistance of the fascia renders it difficult to ascertain the fluctuation of the matter: hence collections of matter here have been frequently overlooked.

Beneath the perineal fascia the muscles and principal vessels and nerves of the perineum and the urethra lie, contained in the anterior part of the perineum, whilst the rectum and the sphincter ani muscles occupy its posterior portion. The *muscles* of the perineum are the *erector penis*, *accelerator urinæ*, and the *transversus perinei:* these muscles bound a triangular space in which our incisions pass in performing the operation of lithotomy; the erector penis and crus penis bound the space *externally*, the accelerator urinæ *internally*, the apex is *in front*, where these muscles converge, the base is *posteriorly*, and is formed by the transversus perinei muscle and accompanying vessels and nerves; through this space the perineal vessels and nerves pass from behind forwards. The trunk of the internal pudic artery lies to the outer side of the perineum on the inner surface of the tuber ischii; it is here covered by the obturator fascia, and lies at about the distance of one inch from the edge of the bone and nearly three inches from the external skin; from these relations it is endangered in the operation of lithotomy. The *erector penis* lies on the crus penis, and thus is enabled, by compressing this body against the bone, to cause the erection of the penis, by forcing the blood forward into the corpus cavernosum or by preventing the return of the venous blood. The *accelerator urinæ* muscle is united with its fellow on the mesial line; the two muscles thus united surround the bulb and commencement of the corpus spongiosum urethræ, and are enabled by their contraction to eject from this portion of the canal the semen, or the last drops of urine. When passing instruments along the urethra, the spasmodic action of these muscles frequently prevents their introduction; by keeping the instrument steadily in the part for a few minutes, the spasm subsides and allows of the entrance into the bladder. The *transversus perinei* muscle crosses near the centre of the perineum, from the tuber ischii inwards to the common central point of the perineum, and thus divides it into its anterior and posterior portions; this muscle is accompanied by the transversus perinei artery and nerve which lie on its anterior surface.

On removing the acceleratores urinæ muscles the bulb of the urethra is exposed: this part lies beneath and a little in front of the arch of the pubes; posteriorly, it is connected to the anterior surface of the anus by a ligamentous chord, about three quarters of an inch in length; this is called the common central point of the perineum from its affording attachment, anteriorly, to the acceleratores urinæ muscles, posteriorly, to the sphincter ani, and on either side to the transversus perinei.

Above the muscles of the perineum it may be observed that, from the bulb backwards to the bladder, the urethra is fixed by a dense fibrous structure, the *triangular ligament* of the urethra, so that we cannot alter the natural direction of this portion of the canal; hence it is necessary, when passing a catheter or other instrument along the canal, to cause its point to ascend as soon as it has arrived at the bulb; this is done by depressing the handle, the instrument being pushed onwards at the same time, when its point will pass upwards and backwards into the bladder; if this manœuvre be not adopted and the instrument pushed onwards, its point may penetrate the bulb, and thus pass into the space between the inferior fundus of the bladder and the rectum.

The *triangular ligament* of the urethra, or *deep perineal fascia*, is a dense layer of aponeurotic fibres, which fills up the perineal space in front, lying above the muscles of the perineum and beneath the bladder; it is attached on each side to the ramus of the ischium and pubes, where it is continuous with the obturator fascia; its apex turned forwards lies above the urethra and splits into two layers which inclose the subpubic ligament, and are lost on the anterior and posterior surfaces of the os pubis; its base directed backwards is semilunar, to accommodate the rectum, on which and the levator ani it is gradually lost, becoming continuous with the perineal fascia. The membranous portion of the urethra passes through this ligament near its centre, at about one inch below the arch of the pubes; as the urethra passes through the ligament two layers pass off from it; one of them, the *anterior* or *descending* layer, passes downwards and forwards on the urethra, forming the fibrous covering of the corpus spongiosum urethræ; the other, the *posterior* or *ascending* layer, passes upwards and backwards, forms the capsule of the prostate gland, and is lost on the bladder. The triangular ligament is of use in supporting the pelvic viscera, and by fixing the urethra it prevents extravasated urine extending from the perineum to the pelvis, or vice versâ. In the angle behind the bulb of the urethra and between the layers of the triangular ligament Cowper's glands are lodged.

Some small muscles or fasciculi of muscular fibres are described with the perineum under the name of Guthrie's or Wilson's muscles, and the compressor venæ dorsalis penis. They are very delicate and pale, and generally so imperfectly developed that some anatomists doubt the propriety of admitting them as distinct muscles.

Mr. Guthrie's muscle on each side is triangular in shape; it arises pointed from the ramus of the ischium, from which the fibres, spread out in a fan-like manner, surround and embrace the membranous portion of the urethra and Cowper's glands and meet in the mesial line of the tendinous raphe, which extends from the prostate to the bulb of the urethra; some of the fibres appear to pass up perpendicularly towards the symphysis pubis.

Wilson's muscle, considered by many to be merely the anterior fibres of the levator ani, appears to arise from the inferior edge of the symphysis pubis, and is lost in the fibres of Guthrie's muscle, or to pass down on each side of the membranous portion of the urethra and unite beneath it, so as to support the urethra as in a sling. The action of these muscles (if admitted) is obvious from their situation.

The *compressor venæ dorsalis penis*, or Houston's muscle, on each side is about an inch in length; it arises from the ramus of the os pubis above the erector penis, ascends forward and inward, and unites with the opposite muscle by a tendon over the dorsal vein in the mesial line. The action of these muscles consists in compressing the vein, and preventing the escape of blood from it during erection.

THE INFERIOR EXTREMITIES

are connected to the pelvis or lower part of the trunk by means of several muscles and the ligaments of the hip-joint. Each extremity is divided into the thigh, leg, and foot; in these, several regions of much practical importance present themselves, and will be considered as we proceed; these are, the *femoral*, the *gluteal*, the *popliteal*, and the *plantar* regions.

On raising the integuments from the fore and inner part of the thigh, a quantity of subcutaneous cellular tissue, the *superficial fascia*, is brought into view; this is continuous with the superficial fascia of the abdomen, scrotum, and perineum; in the groin it is thick and laminated, but elsewhere is loose and irregular; its external surface is identified with the deep surface of the integuments; its deep surface is loosely connected to the fascia lata, except in the groin, where it is firmly attached to the cribriform fascia. In the superficial fascia several arteries, veins, nerves, and glands, may be observed; the arteries are the external pudic, the superficial epigastric, and the externa circumflexa ilii; they arise from the femoral artery a little below Poupart's ligament, and soon penetrate the fascia lata to be distributed in the surrounding integuments. The *external pudic* are lost in the integument on the upper and inner part of the thigh, the scrotum, and penis; the *superficial epigastric* winds upwards over Poupart's ligament towards the umbilicus; the *externa circumflexa ilii* passes upwards and outwards towards the crest of the ilium; these branches, although small in the natural state, become frequently very much enlarged in diseases of the surrounding parts, and will, if divided, require the ligature. The external pudic are in general wounded in the operation of castration, and the superficial epigastric in the operations for the relief of strangulated inguinal and femoral hernia. The veins met with in this region are the trunk and branches of the internal saphena vein; this vessel commences at the side of the foot, ascends over the internal malleolus along the inner side of the leg and knee into the inner and fore part of the thigh; it here continues its course upwards, turning slightly outwards, and about one and a half or two inches below Poupart's ligament perforates the cribriform fascia to join the femoral vein; in this course the saphena vein receives several branches from the surrounding integuments; shortly before its termination two or more vessels of considerable size, from the outer and fore part of the thigh, empty themselves into it along with some of smaller size from the abdominal parietes and scrotum.

In the several operations on the femoral artery, and in that for the relief of the strangulated femoral hernia, the saphena vein is much endangered, and should be avoided. This vein is liable to become varicose, particularly in the leg and foot, from its great length and its superficial course beneath the skin where it is unsupported by the fascia. Several operations have been proposed for the relief of this disease, but most if not all of these have been now abandoned from the great danger of venous inflammation following any wound of the vessel.

The nerves met with in the superficial fascia are chiefly branches of the anterior crural nerve which perforate the fascia lata a little below Poupart's ligament, and descend principally on the anterior and outer part of the thigh towards the knee. Two or three branches of the inguino-cutaneous nerve also will be found taking this course.

The glands are lodged in the groin, and there form the inferior or vertical set of inguinal glands; they are divided into two sets, a superficial and deep: the superficial are four or five in number and are inclosed in a capsule formed by the superficial fascia; the deep are three or four in number and lie beneath the fascia lata, close to the femoral vessels; one of these generally closes up the femoral ring: through these glands the absorbents of the lower extremity pass to join the pelvic and lumbar glands. The two sets of glands communicate by means of absorbents passing from one to the other. These glands are arranged in the vertical direction, whilst the superior set ranged along Poupart's ligament are placed transversely.

In a practical point of view it is of much importance to distinguish these two sets of glands, as the superior alone communicate with the absorbents of the genital organs. The inferior set, on the contrary, communicating with the absorbents of the lower extremity, become inflamed in cases of wounds or diseases affecting the foot, leg, or thigh; hence, if we meet with enlargement of these we should carefully examine the limb, and not attribute the swelling to any disease of the genital organs. Mistakes of a very serious nature have frequently arisen from overlooking this important distinction. The inguinal glands are liable to scrofulous and other indolent swellings; from their position in the groin they may be mistaken for a femoral hernia, or from having pulsation communicated to them by the femoral artery, which lies directly beneath them, they may be confounded with femoral aneurism. Abcesses, or ulcerations of these glands, have been known to make their way into the interior of the femoral artery, and thus give rise to a serious hemorrhage, requiring the operation of tying the external iliac artery for its suppression.

On raising the superficial fascia, (which may be done with much facility, except opposite the cribriform fascia, owing to the connexion which exists between these two structures and the numerous vessels passing in and out at this point,) the fascia lata is exposed: this is a dense layer of fibrous aponeurotic structure which invests the thigh: externally it is much stronger than internally, where, in many cases, it is with difficulty distinguished. Inferiorly the fascia lata is attached to the condyles of the femur and the different tendons around the knee-joint: a strong aponeurosis descends from it on either side of the patella and the ligamentum patellæ, and goes to be inserted into the spine of the tibia, where it is continuous with the fascia of the leg; as the fascia lata ascends upon the thigh it sends septa between the muscles, which form sheaths for these and binds them down; on the posterior surface of the thigh it is attached to the linea aspera in its whole length, as also to the tendon of the glutæus maximus and the short head of the biceps. Superiorly the fascia lata becomes attached on the posterior part to the sacrum and coccyx, and the crest of the ilium; it is more thin and weak where it covers the glutæus maximus muscle, but at the anterior edge of this muscle becomes strong and well marked where it covers the tensor vaginæ femoris and glutæus medius. On the anterior part of the thigh the fascia lata is attached to Poupart's ligament, and internally to the ramus of the ischium and pubes; in the centre of this region, a short distance below Poupart's ligament, it leaves a small oval aperture closed up by the cribriform fascia, through which several veins and nerves pass in and out, and through which a femoral hernia frequently escapes; in other situations also, the fascia lata presents small foramina for the passage of veins or nerves to or from the integument. In some situations, and particularly on the outer side, the fascia lata may be divided into two laminæ of fibres, the external of which take a circular or transverse course, the internal a longitudinal direction; opposite the hip-joint a deep process of considerable strength goes to be attached to the capsule of the joint and the outer head of the rectus muscle; the fascia lata binds down the muscles and vessels of the thigh, affording points of attachment to some of the former.

Wounds of the fascia lata, particularly those of a punctured nature, are frequently followed by a severe inflammation beneath the fascia; sometimes, but rarely, this occurs without any very evident cause. In such cases, should the inflammation not yield to the judicious use of antiphlogistic remedies, a free and early incision becomes necessary, not only to give exit to any matter that may have formed, but also to relieve the tension of the fascia, and thus lessen the inflammation and alleviate the sufferings of the patient.

When the fascia lata has been raised, the femoral artery and vein, and the anterior crural nerve of the thigh will be brought into view by a very little further dissection.

The femoral artery pursues its course through that part of the thigh which is generally known by the name of

THE FEMORAL REGION.

Although no natural boundaries exist to separate this region from the others of the thigh, we may, for the purposes of description, consider it to comprise the anterior and inner part of the thigh, bounded above by Poupart's ligament, below by the knee-joint, and extending on either side as far as on a level with the femur.

In this region are the principal vessels of the lower extremities: the first of those we shall proceed to is the

ARTERIA FEMORALIS.

The external iliac artery emerging from beneath Poupart's ligament enters the femoral region and here assumes the name of *femoral;* from Poupart's ligament, then the femoral artery passes obliquely downwards, backwards, and inwards, first lying on the anterior surface of the femoral region, then on its inner side, and finally, at the junction of the middle and inferior thirds of the thigh, it passes through a tendinous opening in the triceps to the back of the thigh, where it enters the popliteal space and assumes the name of popliteal artery. A line drawn from the centre of Poupart's ligament to the inner surface of the internal condyle, will nearly indicate the course of the artery. In this course the femoral artery has been divided into three stages, the *first* being its passage through Scarpa's triangle, the *second* from the apex of this triangle to the entrance of the vessel into Hunter's canal, and the *third* being its course in this canal.

Scarpa's triangle is that triangular space in the anterior and upper part of the thigh, which is bounded externally by the sartorius, internally by the adductors; its base is formed superiorly by Poupart's ligament, its apex below by the decussation of the sartorius and adductor muscles.

In this space, the most important of the stages of the femoral artery, this vessel lies superficial, being covered only by the integument, superficial fascia, and fascia lata; it rests, first, on the psoas magnus which separates it from the hip-joint, next, on a number of vessels and nerves, and some cellular substance which intervene between it and the insertions of the pectineus and adductor brevis, and lastly, on a portion of the adductor longus. To the inner side of the femoral artery, and on the same plane with it, lies the femoral vein, at least, near to Poupart's ligament; as we approach, however, the apex of the triangle, the femoral vein inclines to the posterior surface of the artery. The two vessels are enclosed in a funnel-shaped sheath, formed by the fascia transversalis and the fascia iliaca, which descend from the pelvis, the former in front, the latter behind the vessels into the thigh, and are gradually lost at the lower part of Scarpa's triangle in the common sheath of the vessels; the artery and vein are not in close contact in this sheath, being separated by a thin but strong partition which passes behind from the fascia transversalis to the fascia iliaca. To the outer side of the femoral artery lies the anterior crural nerve; this, one of the largest of the branches of the lumbar plexus, descends from beneath Poupart's ligament, between the psoas magnus and iliacus internus muscles, the former of which, therefore, separates it from the femoral artery. In most subjects there is an interval, varying from half an inch to an inch, between the anterior crural nerve and the femoral artery, but in some few instances they are in close contact; in all cases a large branch, the internal saphenous nerve, descends from the anterior crural nerve, and soon applies itself to the outer side of the artery.

In its middle stage, which extends from the apex of

Scarpa's triangle to the commencement of Hunter's canal, the femoral artery is more deeply situated, being covered by the integuments, superficial fascia, fascia lata, and the sartorius; the femoral vein lies here posterior, but closely connected to it, and the saphenous nerve lies to its outer side, also in close contact with it.

In its third stage the femoral artery lies in a tendinous canal, called after the celebrated John Hunter, who recommended the femoral artery to be tied here for the cure of popliteal aneurism.

This canal is triangular in shape, the apex is turned backwards towards the linea aspera, and is formed by the junction of the inner and outer walls of the canal; the base is directed forwards, and is formed by a tendinous aponeurosis, which passes off from the vastus internus to the adductor muscles; its inner wall is formed by the adductor magnus and longus; its outer wall by the vastus internus. The tendinous aponeurosis, which forms the base or roof of Hunter's canal, varies much as to strength and extent, in some being strong and well marked, in others little better than a fascia; superiorly it commences gradually, and frequently reaches close to the apex of Scarpa's triangle; but inferiorly terminates at the junction of the middle and inferior thirds of the thigh, in a well-defined semilunar edge, beneath which the internal saphenous nerve and a small artery pass. The femoral artery is here also covered by the sartorius. It lies within the canal with the internal saphenous nerve and the femoral vein, the former being in front, the latter behind the artery, but in close contact with it. At the lower part of Hunter's canal, the femoral artery escapes into the popliteal space, through an oval-shaped tendinous opening, bounded superiorly by the tendons of the adductor longus and magnus, externally by the vastus internus, internally by the tendon of the adductor magnus, and inferiorly by the conjoined tendons of the vastus internus and adductor magnus.

All the principal branches of the femoral artery, except one, are given off from its first stage, namely, the superficial epigastric, the external pudic, the external circumflexa ilii, and the profunda. In its second stage, no branch of any importance arises from it, and in its third stage but one, namely the anastomica magna.

1. *Arteria epigastrica superficialis*, small in size, arises from the fore part of the femoral artery, about half an inch below Poupart's ligament, runs forwards, pierces the fascia lata, turns upwards over Poupart's ligament, and ascends beneath the integuments towards the umbilicus, where it terminates. It is almost impossible to avoid this artery in the operation for the relief of either strangulated inguinal or femoral hernia; when wounded it should be secured with the ligature, if the hemorrhage be inconvenient.

2 and 3. *Arteriæ pudicæ superficiales* vel *externæ* are generally two small branches, which arise near the preceding, and run inwards, one beneath, the other superficial to the fascia lata, towards the pubes, where they are lost in the external organs of generation. These arteries become much enlarged in any long-continued disease of the testis or scrotum, and will, if divided in any operation for the relief of such disease, require the application of the ligature. They may also be divided in the operation for the relief of strangulated inguinal or femoral hernia.

4. *Arteria circumflexa ilii externa*, smaller than the preceding, arises near them; it runs upwards and outwards, parallel to and beneath Poupart's ligament, towards the crest of the ilium, where it is lost in the integuments.

5. *Arteria profunda femoris*. This, nearly as large as the continuation of the femoral artery, arises from its external and posterior part about one inch and a half or two inches below Poupart's ligament, but much more frequently above than below this point, not unfrequently as high up as even above the ligament; from this point, the profunda first passes outwards, then turns inwards and backwards, passing behind the femoral artery, and separated from it by the femoral and profunda veins, and some small nerves, and then descends along the inner side of the femur, nearly parallel to, but at some distance behind, the femoral, and a little below the middle of the thigh terminates in a muscular branch. In this course the pro-

funda artery first lies on the psoas and iliac muscles, then crosses the cruræus and vastus internus, and descends in front of the insertions of the pectineus and adductor brevis, behind the tendon of the adductor longus, to its termination. The profunda artery in the first part of its course only is superficial, being covered by the integument and fascia. The branches of the profunda are the two circumflex arteries, the three perforating arteries, and the terminating branch.

Arteriæ circumflexæ. These arteries, two in number, arise sometimes by a common trunk, sometimes separately, from nearly opposite points of the profunda, shortly after its origin.

The *external* circumflex artery is in general the first; it runs outwards, between the branches of the anterior crural nerve, in front of the psoas and iliac muscles, and behind the sartorius and rectus, and soon divides into a lash of branches, some of which *ascend* beneath the sartorius and tensor vaginæ femoris, pass between the gluteus medius and minimus, towards the crest of the ilium, where they terminate in the supply of the gluteal muscles, and by anastomosing with the circumflexa ilii and gluteal arteries; other branches take a *circular* course around the outer side of the thigh, perforating the muscles in this situation, and arrive at the back of the thigh, where they anastomose with the branches of the gluteal, sciatic, and internal circumflex arteries; the principal branches of the external circumflex artery *descend* accompanied by branches of the anterior crural nerve, sink between the cruræus and vastus externus, and terminate in the supply of these muscles, also the rectus and the vastus internus, anastomosing in these with the muscular branches of the femoral artery, and the articular arteries of the knee-joint.

The *internal* circumflex artery, in general larger than the preceding, passes from its origin inwards and backwards, above the trochanter minor, through a triangular space, bounded above by the obturator externus, externally by the neck of the femur, and psoas and iliacus tendons, and internally by the adductors, reaches the back part of the thigh, between the lower margin of the quadratus femoris and the upper edge of the adductor magnus, and terminates by anastomosing with the branches of the external circumflex, gluteal, sciatic, and perforating arteries. In this course, the internal circumflex artery gives off numerous branches to the pectineus, adductor brevis, longus, and magnus, obturator and gracilis muscles, in which they anastomose with branches from the obturator artery; one or two small branches proceed from it through the notch in the inner edge of the acetabulum, beneath the cotyloid ligament, to the supply of the ligamentum teres, head of the femur and synovial membrane of the hip-joint. The circumflex arteries are exceedingly irregular as to origin, and frequently arise from the trunk of the femoral artery.

Arteriæ perforantes. These arteries, three in number, are so named from their perforating the adductor tendons to arrive at the back part of the thigh. *Prima* arises opposite the lesser trochanter, passes backward between the pectineus and adductor brevis or sometimes through the latter, perforates the adductor magnus, and gains the back of the thigh. *Secunda*, larger than the preceding, perforates the adductor brevis, then the adductor magnus, and arrives at the back of the thigh. *Tertia* arises opposite the upper edge of the tendon of the adductor longus, perforates the adductor magnus, and gains the back of the thigh. The perforating arteries supply the muscles on the inside of the thigh; they form a chain of anastomoses along the back part of the thigh with the gluteal, sciatic, and circumflex arteries, and the articular arteries of the knee-joint beneath, which is of essential service in restoring the circulation, when any of the principal arteries of the lower extremities has been tied. Sometimes a fourth perforating artery exists.

Arteria terminans is a large branch of the profunda which descends between the rectus and cruræus muscles to the knee, where it anastomoses with the articular arteries.

Arteria anastomotica magna arises from the femoral, as this vessel is about becoming popliteal; it descends in the substance of the vastus internus to the knee, where it anastomoses with the articular arteries. The *saphenous nerve* leaves the femoral artery at the lower part of Hunter's canal, and there joins the anastomotica magna, which it accompanies as far as the knee; this nerve afterwards escapes from beneath the tendon of the sartorius, and between the tendons of the gracilis and semitendinosus on the inner side of the tibia, and then accompanies the internal saphena vein.

The numerous branches of the femoral and profunda arteries which descend to the knee, become much enlarged in disease of this articulation: hence in amputations of the thigh, for long-continued disease of the knee-joint, most of these vessels will be found much enlarged, and will require to be secured with the ligature.

We may now proceed to consider the operations on the femoral artery.

The femoral artery is tied in its first stage, i. e. in Scarpa's triangle for the cure of popliteal aneurism. To perform this operation, place the patient in the recumbent position, with the limb nearly in a state of extension, and rotated slightly outwards. The course of the artery is at once recognized by the pulsation of the vessel, or, if this be not manifest, it may be ascertained by a line drawn from the centre of Poupart's ligament to the internal condyle. Some have also recommended the inner edge of the sartorius as a guide to the artery, but this is objectionable, as the muscle does not run parallel to the artery. Make an incision through the integuments and fascia, about four inches in length, over the course of the vessel, commencing about one inch below Poupart's ligament. As the internal saphena vein lies to the inner side of our incision, we should take care not to prolong it too much towards the inner side of the thigh. In this incision, some superficial blood-vessels and nerves will be wounded, and one or more of the inguinal glands brought into view; those may be cut through with impunity. The edges of the wound having been separated, the fascia lata will be exposed. Make a small opening through this, and then introduce a director beneath it, and so divide the fascia to a sufficient extent. The sheath of the femoral vessels will soon be brought into view, and the artery recognized by its pulsation. Proceed to open the sheath with much caution. For this purpose pinch it up between the fingers, a little to the outer side of the artery; make a small opening into it, and through this introduce the director and slit open the sheath. The femoral artery being thus exposed, it should be separated from the vein on its inner side, and from the saphenous nerve on its outer side.

There is little difficulty in doing this, as a septum exists between the artery and vein, and the nerve is seldom in close contact in this situation. The artery having been isolated, the aneurism needle is to be passed from within outwards, so as to avoid injuring the vein. The place at which the ligature should be applied is a short distance, say three inches, from Poupart's ligament: this is about one inch or one inch and a half below the origin of the profunda, as this vessel arises in general about one inch and a half or two inches from Poupart's ligament; and it is necessary to have a portion of the femoral artery intervening between the ligature and its origin, in order to allow of the formation of an internal coagulum, and the subsequent obliteration of the femoral artery.

The ligature should not be applied on the femoral artery above the origin of the profunda, as a sufficiently free space does not exist here for its application, in consequence of the origin of the superficial epigastric, pudic, and circumflex ilii arteries. The great advantage of tying the femoral artery below the origin of the profunda is that, by so doing, we avail ourselves of the important anastomosis of this vessel with the branches of the iliac arteries above, and the articular arteries around the knee-joint below, by which means the blood is at once carried into the lower part of the limb. Before applying the ligature, it should be ascertained by compressing the artery between the finger and thumb that it commands the circulation in the aneurismal sac; for in some instances the profunda arises from the femoral, near to Poupart's ligament, and descending in a parallel direction, may be mistaken for it. A very remarkable case of this kind occurred to Sir C. Bell, in which the two vessels communicated in the thigh below the point, where the ligature was applied, and thus the operation was rendered of no avail.

In the preceding description we have not spoken of the sartorius nuscle, as we consider it can only serve as a guide, when it is our bject to tie the artery at the lower part of Scarpa's triangle, where he sartorius approaches the femoral artery.

Mr. Hunter first tied the femoral artery in the tendinous anal, formed between the triceps and the vastus internus nuscles. This operation has been of late almost abanloned, being liable to the following objections: the rtery lies much deeper here than in Scarpa's triangle; t is also too near the diseased portion of the artery; the emoral artery and vein are in close contact, and the tenlinous structure of the surrounding parts is unfavorable o the formation of granulations, and consequently to the nealing of the wound formed by the operation. The emoral artery has been recommended however by some o be tied here in cases of aneurism of the arteries of the eg, thigh, and hip; or in wounds of these vessels, caused y a fracture of one or other of the bones of the leg.

OPERATION IN HUNTER'S CANAL.

Place the limb in the semiflexed position, and resting n its outer side, make an incision about four inches in ength along the middle third of the thigh, and over the ourse of the femoral artery. Some caution is necessary n making this incision, as the saphena vein lies but a hort distance internal to this point. The integuments, uperficial fascia, and fascia lata having been cut through, he anterior margin of the sartorius will be exposed; this nuscle should be drawn to the inner side, and the tenlinous covering of Hunter's canal will be brought into iew: this is to be cautiously cut through, when the emoral vessels and the saphenous nerve will present themelves; the nerve will be found in front of the artery and he vein behind it. The artery and vein are here in close ontact, and can with difficulty be separated; this having een accomplished, the aneurismal needle is to be passed ound the artery, and the ligature secured.

This operation is much more difficult than that of tying he femoral artery in Scarpa's triangle. If the operator e not cautious he may mistake the vastus internus for the sartorius, and so proceed to separate the fibres of the former, until the appearance of the bone (as has occurred) informs him of his error. This mistake may be avoided by paying attention to the course of the fibres of the two muscles. It is possible, also, that the anastomotica magna artery may be mistaken for the femoral; but this is not likely, unless that vessel has become more than usually enlarged.

The muscles with their origin and insertion, and also the nerves within the femoral region, having been described in another part of this work, we shall now proceed to describe

THE GLUTEAL REGION.

This region is situated on the back and upper part of the thigh, bounded superiorly by the crest of the ilium, internally and posteriorly by the sacrum, coccyx, and perineum, anteriorly by a line drawn vertically downwards, from the spine of the ilium, and inferiorly by the fold of the nates; it is covered by the gluteus maximus and medius muscles.

On raising the integuments from this region, several small nerves will be exposed; they are branches of the lumbar and sacral plexuses and the sciatic nerve. Small arteries and veins are also met with, but they are of no practical importance. The superficial fascia covering this region is loaded generally with a large quantity of adipose tissue; on raising this the fascia lata is exposed. This is thin and weak posteriorly, where it covers the gluteus maximus, but is dense and strong anteriorly over the gluteus medius. On raising this, the muscles of this region may be examined: they are nine in number, viz.,

Gluteus maximus.
.... *medius.*
.... *minimus.*
Pyriformis.
Gemellus superior.
.... *inferior.*
Obturator externus.
.... *internus.*
Quadratus femoris.

In disease of the hip-joint the gluteus maximus muscle becomes relaxed, and its surface is flattened, and the fold of the nates sinks lower than on the opposite side ; these symptoms are not confined to morbus coxæ, but will be met with in many other affections, more particularly in paralysis of the limb.

A deep fossa exists in the living subject behind the trochanter major; here issues are most frequently inserted in the disease named morbus coxæ, or any other affection which may require a local irritant for its removal.

On raising the gluteus maximus the following parts are brought into view from above downwards; the gluteus medius, the pyriformis, and between these, the gluteal vessels and superior gluteal nerve; below the pyriformis the great and lesser sciatic nerves pass out, as also the sciatic and pudic arteries; all these parts, with the exception of the gluteus medius, escape through the great sciatic notch; below these are the superior gemellus, the obturator internus tendon (which passes out through the lesser sciatic notch as the internal pudic artery enters,) the inferior gemellus, the quadratus femoris, and beneath these the tendon of the obturator externus. The tuber ischii, and the origins from it of the hamstring muscles, and the great sciatic ligament, are also seen in this dissection. The muscles of this region are of much service in strengthening the hip-joint, like the muscles on the anterior and inner part of the thigh which are attached to the pelvis; they also serve to fix the pelvis on the lower extremity when this itself is fixed, as in the standing position; most of the small muscles around the hip-joint are ruptured in dislocation of this articulation. In dislocation on the dorsum of the ilium the head of the femur lies under cover of the gluteus maximus and medius, and on the torn fibres of the gluteus minimus; in dislocation into the obturator foramen, the obturator externus is the only muscle relaxed. In the dissection of the preceding muscles several vessels and nerves of importance are met with; the principal arteries are the gluteal, sciatic, and pudic branches of the internal iliac artery. The gluteal artery escapes through the upper part of the great sciatic notch, above the pyriformis muscle, and accompanied by the superior gluteal nerve; it soon divides into numerous branches which are distributed to the muscles in the gluteal region, and anastomose with the circumflexa ilii, circumflexa femoris, sciatic, and pudic arteries. The sciatic artery passes out also through the great sciatic notch, but below the pyriformis; it descends with the sciatic nerve between the tuber ischii and the great trochanter, and is distributed to the surrounding muscles; the pudic artery passes out with the preceding, winds around the spine of the ischium, and enters the pelvis through the lesser sciatic notch, ascends forwards and inwards along the inner side of the tuber ischii, and the ramus of the ischium, and pubes, and is lost in the perineum and the organs of generation. Each of these arteries is accompanied by a corresponding vein which terminates in the internal iliac vein.

The principal nerves are the superior gluteal, the greater and lesser sciatic, and pudic. The superior gluteal nerve is a branch of the lumbo-sacral; it passes out with the gluteal artery, and is lost in the gluteal muscles. The lesser sciatic or inferior gluteal nerve, is a branch of the sacral plexus; it passes out with the sciatic and pudic arteries, and soon divides into three branches: first, the gluteal is distributed to the gluteal muscles; the second, the pudic branch, winds round the tuber ischii and is lost in the integuments of the perineum and scrotum; the third, the posterior cutaneous nerve of the thigh descends, perforates the fascia lata, and is lost in the integument covering the back of the thigh, reaching as far down as the popliteal space; the pudic nerve is also a branch of the sacral plexus, and accompanies the pudic artery. The great sciatic nerve is the terminating branch of the sacral plexus; it escapes from the pelvis through the lower part of the great sciatic notch along with the sciatic and pudic arteries below the pyriformis, or sometimes between its fibres; descends between the tuber ischii and the great trochanter but nearer the former with the sciatic artery, resting on the superior gemellus, the obturator internus, the inferior gemellus, and the quadratus femoris, covered by the glutæus maximus, and surrounded by a large quantity of loose cellular tissue; it then descends between the biceps and semitendinosus muscles and enters the politeal space, where it terminates by dividing into two large trunks, the internal and external popliteal nerves, which shall be described when we consider that region. The great sciatic nerve, as it descends in the thigh, sends off several branches to the surrounding muscles and integuments.

Along the back of the thigh we meet with the three following muscles, biceps, semitendinosus, semimembranosus; these three muscles, together with the gracilis, form the hamstring muscles.

THE POPLITEAL REGION

is a diamond-shaped space situated behind the knee-joint, bounded by the hamstring muscles and the heads of the gastrocnemius.

On raising the integuments which cover it, the posterior cutaneous nerve, a branch of the lesser sciatic, is exposed in the superficial fascia; beneath these, the popliteal space is covered by a dense layer of aponeurotic structure, the *popliteal fascia*, which is continuous above with the fascia lata, below with the fascia of the leg, on either side it is attached to the neighbouring tendons, the condyles of the femur, and the lateral ligaments of the knee-joint; the popliteal fascia binds down the tendons to which it is attached, and assists in protecting the popliteal vessels and nerves from injury, it is made tense by the contraction of the muscles.

In the disease of popliteal aneurism it has the effect of preventing the enlargement of the tumour posteriorly, and thus causes it to ascend into the inner and lower part of the thigh; it influences popliteal abscesses in like manner. Both these diseases, particularly aneurism, are attended with much pain from the pressure of the popliteal nerves between the tumour and resisting fascia.

On raising the fascia the popliteal space will be exposed; this extends upwards into the inferior fourth of the thigh, and downwards into the superior sixth of the leg, meeting at each extremity in an acute angle, so that the space seems composed of two triangles joined at their bases; it is bounded on the outer side by the biceps tendon, on the inner side by the semitendinosus, gracilis, and semimembranosus, below on either side by the heads of the gastrocnemius, and in front by the posterior surface of the femur, the back of the knee-joint, and the ligamentum posticum of Winslow, the head of the tibia, and the popliteus muscle. This popliteal space is filled with a large quantity of adipose tissue, in which the popliteal vessels and nerves are imbedded. In the lower part of the popliteal space, and between the heads of the gastrocnemius, the external saphena vein ascends; it dips into this space and joins the popliteal vein, and is accompanied by numerous absorbents which ascend from the leg to join the popliteal glands. The popliteal nerves lie superficial in this space; they are derived from the great sciatic nerve which enters the popliteal space at its upper part and divides into the external and internal popliteal nerves. The external popliteal or fibular nerve, the smaller of the two, runs downwards and outwards along the external side of the popliteal space; descends between the tendon of the biceps and the outer head of the gastrocnemius; turns forward, winds round the neck of the fibula beneath the peroneal muscles; gives off several branches to them, and terminates by dividing into two branches, the anterior tibial and musculo-cutaneous nerves; in the popliteal space it gives off a branch which joins a similar branch from the internal popliteal nerve to form the external saphenous nerve. The internal popliteal, or posterior tibial nerve, descends vertically, and nearly in the centre of the popliteal space, lying superiorly to the outer side of the artery, but inferiorly to its inner side, and in more direct contact with it; the nerve passes from this space into the leg in which it descends with the posterior tibial artery, and finally terminates in the sole of the foot in the internal and external plantar nerves. In the popliteal space the posterior tibial nerve gives off several branches to the heads of the gastrocnemius, as also a branch of considerable size, the communicans tibiæ, which joins the corresponding branch from the fibular nerve about the centre of the leg, to form the external saphenous nerve, which thence descends on the outer side of the leg and foot to be lost with the branches of the external saphena vein.

On removing a quantity of fat which separates the popliteal nerve from the vein and artery, these will be exposed lying in direct contact, the vein being posterior or superficial to the artery and a little to its outer side at the upper part of the space.

THE POPLITEAL ARTERY,

the continuation of the femoral, enters the upper and inner part of the popliteal space on the internal surface of the femur, through the opening already described in the triceps, from thence it runs obliquely downwards and outwards, first, along the inner side and then along the centre of the popliteal space, and finally escapes from it by passing beneath a semilunar tendinous arch formed between the heads of the soleus muscle, and at the lower edge of the popliteus muscle terminates by dividing into the anterior and posterior tibial artery. In this course the popliteal artery lies, first, on the posterior surface of the femur with the intervention of a few muscular fibres and adipose tissue; in the middle on the ligamentum posticum of Winslow, from which it is frequently separated by one or two lymphatic glands;[*] and finally on the popliteus muscle; it is bounded on either side by the lateral boundaries of the popliteal space. The popliteal artery gives off five articular arteries and some muscular branches.

1 and 2. *Arteriæ articulares superiores, externa et interna. Arteria externa* winds upwards and outwards from the popliteal artery above the external condyle of the femur close to the bone, supplies the neighbouring muscles on the extremity of the femur, and terminates by

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[*] If one or both of these glands become enlarged, they may press backwards the popliteal artery, and thus form a tumour in the ham that may be mistaken for a popliteal aneurism; the diagnosis is not difficult. These glands sometimes suppurate and form a large abscess in the popliteal space.

anastomosing in front of the patella with the other articular arteries, the anastomotica magna from above, and the anterior tibial recurrent from below. *Interna* pursues a similar course to the preceding, but on the inner side of the femur, and terminates, like the other, on the anterior surface of the patella.

3. *Arteria articularis media*, vel *azygos*, proceeds from the anterior part of the popliteal artery, perforates the ligamentum posticum of Winslow, and supplies the interior of the knee-joint.

4 and 5. *Arteriæ articulares inferiores*, *externa et interna*. *Externa* runs upwards and outwards from the popliteal artery towards the outer side of the knee-joint, passes between the external lateral ligament and the external semilunar cartilage in a groove in the latter, and terminates in supplying the knee-joint and surrounding muscles, and in the anastomoses in front of the patella. *Interna* runs downwards and inwards below the internal condyle of the tibia, passes forwards between the internal lateral ligament and the bone, and terminates as the preceding; all the articular arteries run very close to the knee-bones.

These arteries are of much importance in reestablishing the circulation in the lower part of the limb, when the femoral artery has been tied for the cure of popliteal aneurism; they are, indeed, the only vessels of magnitude that are available for this purpose: hence, in all cases where the circulation in these is impeded, as occurs in large aneurismal tumours, the due supply of blood to the lower part of the limb is prevented, and mortification results.

Besides the foregoing arteries, the popliteal sends off numerous branches to the surrounding muscles, more especially to the heads of the gastrocnemius.

The popliteal artery may be tied in any part of its course by making an incision from three to four inches in length in the direction of the vessel, which shall cut through the integuments and fascia; the nerve being drawn out of the way, the popliteal vessels will be exposed by a little further dissection; the artery being isolated, the ligature is to be passed round it and secured. If the operation is performed in the upper third of the popliteal space, the incision should be made along the outer border of the semimembranous muscle, which will lead directly to the artery. In the middle and lower thirds the incision should be made directly on the mesial line; in the latter operation the external saphena vein is endangered; the most convenient posture of the patient will be on the face.

The operation of tying the popliteal artery is not to be recommended; the depth at which the artery lies, the contiguity of the knee-joint, and the close connexion between the artery and vein, conspire to render it both a difficult and dangerous operation. The only cases which can possibly call for its performance are,—if wounded here,—in aneurisms of the arteries of the leg, or wounds of them from splinters of fractured bones; indeed, in the two latter cases we should prefer tying the femoral artery in its lower third.

THE LEG.

Raise the integuments from the anterior and posterior surfaces of the leg and dorsum of the foot, and the superficial fascia is exposed; in this, two large superficial veins may be seen, the internal and external saphena veins. The internal saphena vein, much the larger of the two, commences by numerous small branches from the dorsum and inner side of the foot: these unite in one trunk, which crosses the internal malleolus, sometimes behind it, ascends along the inner side of the leg a little behind the inner edge of the tibia, receiving in its course numerous branches from the integuments; it then ascends over the internal condyle of the femur near its posterior part, enters the thigh, continues its course upwards along the inner surface of the thigh, where it becomes much increased in size from the addition of numerous branches, turns outwards, perforates the cribriform fascia, and terminates in the femoral vein, an inch and a half below Poupart's ligament.

The external or posterior saphena vein, commences by small veins from the integuments, covering the heel and outer side of the foot, ascends over or behind the external malleolus, sinks beneath the fascia of the leg, passes upwards between it and the gastrocnemius muscle along the posterior surface of the leg, and terminates in the popliteal vein; sometimes it joins the internal saphena vein in the leg: they always communicate freely. The external saphena vein is accompanied by the external saphenous nerve, a branch formed from the posterior tibial and fibular nerves.

Several cutaneous nerves, in addition to the two saphenous, are met with in the superficial fascia; the largest of these is the musculo-cutaneous nerve, a branch of the fibular, which perforates the fascia on the anterior surface of the leg at the junction of its middle and inferior thirds, and descends to supply the integument on the dorsum of the foot.

Beneath the superficial fascia lies the fascia of the leg; this is derived superiorly from the fascia lata, and is continuous with the tendons around the knee-joint. In the upper part of the leg it is attached to the heads of the tibia and fibula; from this it descends to cover the muscles of the leg, being attached to the margins of the tibia and fibula, until it arrives near the ankle-joint; it here becomes continuous with the annular ligaments of the articulation, and is attached to the external and internal malleoli. The fascia of the leg is stronger superiorly than inferiorly, and on the anterior than the posterior surface; it is wanting over the anterior surface of the tibia, and near the heel is irregular and indistinct; it here winds round the tendo Achillis, and becomes continuous with the fascia covering the deep muscles of the leg. The fascia of the leg is of use in binding down the muscles; it also affords origin to most of them, and sends in septa or partitions between them which become attached to the tibia and fibula.

The annular ligaments are dense fibrous bands, which bind down the tendons in front of and behind the ankle-joint: they are two in number, the anterior and posterior. The *anterior* annular ligament passes across the extensor tendons and anterior tibial vessels and nerve; it arises internally from the internal malleolus and os naviculare, ascends outwards, and is implanted externally into the external malleolus and os calcis; it is stronger here than internally, and extends above the ankle-joint: it forms three distinct sheaths for the passage of the tendons and vessels beneath it, and is lined by a synovial membrane which is reflexed from it on the tendons, and continues for some distance on the dorsum of the foot.

The *posterior* or internal annular ligament is broader and more dense than the anterior; it binds down the flexor tendons and posterior tibial vessels and nerve; it stretches from the internal malleolus backwards and outwards to the inner surface of the astragalus and os calcis.

Raise the fascia from the anterior surface of the leg and the muscles between the tibia and fibula will be exposed; they are four in number, viz.

Tibialis anticus,
Extensor longus digitorum,
Extensor proprius pollicis,
Peronæus tertius.

On the outer part of the leg are the two following muscles:

Peronæus longus,
Peronæus brevis.

The muscles on the back of the leg are seven in number, and are divided into two sets, a superficial and deep, by the posterior tibial vessels and nerves and by the deep fascia; the superficial set consists of three muscles, viz.

Gastrocnemius,
Solæus,
Plantaris.

The deep muscles are four, viz.

Tibialis posticus,
Flexor communis digitorum,
Flexor longus pollicis,
Poplitæus.

On raising the soleus muscle the deep fascia of the leg is exposed: this covers the deep muscles and vessels of the leg; it descends superiorly from the expansion derived from the semimembranous muscle, and which covers the popliteus muscle; is attached to the tibia and fibula, and to the deep muscles. Inferiorly it becomes strong, crosses the tendons of the deep muscles, and becomes attached to the internal annular ligament of the ankle-joint. Beneath the deep fascia of the leg lie the deep vessels and nerves of the leg. We shall now, therefore, proceed to the consideration of the vessels and nerves that supply the leg and foot, and then complete the anatomy of the popliteal artery, and, with it, of the vessels of the lower extremity.

We have stated that the popliteal artery divides at the lower margin of the popliteus muscle into the anterior and posterior tibial arteries: of these the former is the smaller of the two and supplies the parts on the anterior surface of the leg and dorsum of the foot, while the latter supplies the back of the leg and the sole of the foot. We shall first describe

THE ANTERIOR TIBIAL ARTERY.

This artery passes directly forwards from the bifurcation of the popliteal, through the deficiency in the upper part of the interosseous membrane of the leg, close to the inner side of the neck of the fibula, and gains the anterior surface of the leg; it then descends inwards in front of and resting on the interosseous membrane, passes over the ankle-joint beneath the annular ligament, crosses the dorsum of the foot near to its inner edge, runs forwards, and gaining the cleft between the first and second metatarsal bones divides into its two terminating branches, the arteria communicans vel profunda, and the arteria pollicis. A line, drawn from the head of the fibula to the base of the great toe, will run nearly parallel to the course of the anterior tibial artery. In the superior third of the leg the anterior tibial artery lies deep between the tibialis anticus and the extensor digitorum communis; in the middle third also, it lies deep between the tibialis anticus and the extensor pollicis, but in the lower third becomes more superficial, being thrown forwards by the lower extremity of the tibia on which it rests, and lies between the tendons of the extensor communis and the extensor pollicis, which do not conceal it like the fleshy fibres of the muscles; it is here covered by the skin and fascia only. As the anterior tibial artery crosses in front of the ankle-joint, it is but little removed from the synovial membrane of the articulation; it is here covered by the bursa, which envelops the extensor tendons, and which not unfrequently communicates with the joint. On the dorsum of the foot the anterior tibial artery is superficial, being covered only by the integuments, and crossed about the middle of the tarsus by the internal tendon of the extensor digitorum brevis; it here runs over the astragalus, navicular and internal cuneiform bones. The anterior tibial artery is accompanied by two venæ comites, one on each side, and by the anterior tibial nerve, a branch from the external popliteal or peroneal nerve. This nerve, the smaller division of the sciatic nerve, we have already traced through the popliteal space; from this it winds around the neck of the fibula, gives off several branches to the peroneal muscles, and divides into its two terminating branches, the anterior tibial and musculo-cutaneous nerve. The *anterior tibial* nerve runs downwards and outwards, joins the artery of the same name a little above the middle of the leg, and accompanies it, first lying to its outer and then crossing to its inner side, to the dorsum of the foot. Here the nerve divides into two terminating branches, the internal of which is lost in the extensor brevis, the first interosseous muscle, and the integuments on the opposed surfaces of the great and second toes; the external branch is lost in the extensor brevis and interossei muscles. The *musculo-cutaneous nerve* descends between the extensor communis and peronæus longus muscle, perforates the fascia of the leg at the junction of the middle and inferior thirds, becomes superficial, descends to the dorsum of the foot, and terminates in the integuments of the toes, anastomosing on each side with the internal and external saphenous nerves. A few branches from the posterior tibial nerve accompany the anterior tibial artery through the opening in the interosseous membrane.

The anterior tibial artery, besides giving branches to the surrounding muscles, sends off the following branches:

1. *Arteria recurrens* proceeds from the anterior tibial artery, shortly after it has passed through the opening in the interosseous membrane, upwards and inwards through the fibres of the tibialis anticus muscle, sends branches to the integuments, and terminates in the anastomosis in

front of the patella formed by it, the articular arteries, and the anastomotica magna.

2 and 3. *Arteriæ malleolares, externa et interna,* arise from opposite sides of the anterior tibial artery about two inches above the ankle-joint, descend to the malleolus on each side, and are lost in the integuments, in which they anastomose with each other, and with branches from the posterior tibial and peroneal arteries.

Arteria tarsi arises from the anterior tibial artery, as it crosses the os naviculare, proceeds outwards, and is lost in the integuments and muscles on the outer side of the foot.

Arteria metatarsi arises a little in front of the preceding, runs outwards across the heads of the metatarsal bones, supplies the articulations, and sends branches forwards, which supply the three external interosseous spaces and muscles, and anastomose with the digital branches of the plantar arteries. The terminating branches of the anterior tibial artery are the two following:

Arteria pollicis passes forwards to the cleft between the first and second toes, and divides into two branches, one of which, the internal, supplies the integuments on the inner side of the great toe; the other, the external, supplies the integuments on the opposed surfaces of the first and second toes.

Arteria communicans vel *profunda* passes directly through the first interosseous space, and joins the terminating branch of the external plantar artery.

From the superficial course of the anterior tibial artery on the dorsum of the foot, it is here much exposed, and is frequently wounded; the general rule as to wounded arteries applies here.

The anterior tibial artery may require to be tied in the leg for aneurism in its lower part. For this purpose an incision, about three inches in length, should be made over the course of the artery through the integuments and fascia; the muscles now being separated the artery will be exposed, and may be secured, avoiding the nerve and venæ comites. In some cases the anterior tibial artery terminates a little above the ankle; its place on the dorsum of the foot is then supplied by the anterior peroneal artery. When such a variety exists, it is evident that a ligature on the anterior tibial artery will have no effect on an aneurism on the dorsum of the foot. When the leg is amputated a short distance below the tubercle of the tibia, some difficulty is often experienced in securing the anterior tibial artery from its retracting through the foramen in the interosseous membrane; the membrane should be divided, when the artery will be exposed, and may be easily secured.

ARTERIA TIBIALIS POSTERIOR.

This is much larger than the anterior; it proceeds from the bifurcation of the popliteal artery downwards, and inwards along the posterior surface of the deep muscles of the leg, and beneath the deep fascia to the interval between the os calcis and the internal malleolus; it here turns forwards, enters the sole of the foot between the two heads of the abductor pollicis, and terminates by dividing into the internal and external plantar arteries. In the upper and middle thirds of the leg the posterior tibial artery lies deep, being covered by the gastrocnemius, plantaris, and soleus muscles, and the deep fascia; in the lower third it is superficial, being covered only by the integuments and superficial and deep fascia. It rests first on the tibialis posticus, then on the flexor communis, and beneath this on some fat and cellular tissue, which separate it from the tibia and the internal lateral ligament of the ankle-joint. The posterior tibial artery is accompanied throughout by two venæ comites, one on each side, and by the posterior tibial nerve. This nerve, the continuation of the internal popliteal, lies to the outer side of the artery, and between the internal malleolus and heel,—is nearer to the latter than to the artery. In the fossa between the malleolus internus and os calcis the order of parts from the one eminence to the other is, tibialis posticus tendon, flexor longus tendon, posterior tibial artery and venæ comites, posterior tibial nerve, flexor longus pollicis tendon, plantaris tendon, and tendo Achillis.

The posterior tibial nerve terminates like the artery in the sole of the foot by dividing into two branches, the internal and external plantar nerves.

Besides numerous branches to the surrounding muscles and integuments, the posterior tibial artery gives off the following important branch.

Arteria peronæa arises from the posterior tibial artery, a short distance below the popliteus muscle, runs obliquely downwards and outwards towards the fibula, descends along the internal margin of this bone, close to the interosseous membrane, and a little above the ankle divides into its two terminating branches, the anterior and posterior fibular arteries. The *anterior* passes forwards through the interosseous membrane, and joins the branches of the anterior tibial artery; in some cases this artery supplies the place of the anterior tibial artery on the dorsum of the foot. The *posterior* descends behind the external malleolus, and terminates in sending branches to the surrounding parts, and in anastomosing with branches from the posterior tibial and malleolar arteries.

The posterior tibial artery divides between the origins of the abductor pollicis into the internal and external plantar arteries.

Arteria plantaris interna, smaller than the externa, runs forwards along the internal and inferior surface of the tarsus, under cover of the abductor pollicis muscle, as far as the great toe, which it supplies; several branches also proceed from this artery to the surrounding muscles and integuments, which anastomose with the branches from the external plantar artery.

Arteria plantaris externa pursues a curved course in the sole of the foot, so as to form an arch, called the plantar arch, the convexity of which is directed forwards and outwards, the concavity in the contrary direction. From the bifurcation of the posterior tibial, the external plantar artery passes first downwards, forwards, and outwards, between the first and second layer of muscles in the sole of the foot, as far as the base of the fifth metatarsal bone; it then turns inwards and upwards, in nearly a transverse direction, and terminates in the cleft, between the first and second metatarsal bones, by anastomosing with the deep branch of the anterior tibial artery. In this latter part of its course, it runs first between the flexor digitorum brevis and abductor minimi digiti, covered only by the integuments and fascia; but afterwards sinks deep in the sole of the foot, between the adductor pollicis and transversalis pedis, covered by the short and long flexor tendons and the lumbricales. The plantar arch besides giving several branches to the muscles and other soft parts in the foot, sends off the following:

Arteriæ perforantes proceed from the upper surface of the plantar arch, supply the interossei muscles, and anastomose with branches from the anterior tibial artery.

Arteriæ digitales, four in number, arise from the convexity of the plantar arch; the first supplies the outer side of the little toe, the second, third, and fourth, run forwards to the clefts between the fourth and fifth, third and fourth, second and third toes, where each divides into two branches, which supply the opposed surfaces of the second, third, fourth, and fifth toes, near the anterior extremity of each of which they anastomose freely together. The plantar arteries are accompanied by the plantar nerves; these are the terminating branches of the posterior tibial nerve, which bifurcates also between the origins of the abductor pollicis into two branches, the internal and external plantar nerves. The *internal* plantar nerve is the larger of the two; it passes forwards above the abductor pollicis, and supplies the first, second, and third toes, and the inner half of the fourth toe, along the sides of which the branches of nerves accompany the digital arteries to the pulp of the toes, in which they are lost, as in the fingers. The *external* plantar nerve accompanies the plantar arch of arteries, and is lost in the supply of the little toe and the outer half of the fourth toe. The plantar nerves, in their course to the toes, send off numerous branches to the muscles in the sole of the foot.

The posterior tibial artery may require to be tied in any part of its course when wounded, for the cure of aneurism, the consequence of disease or of accident. This is an extremely difficult operation in the upper two thirds of the leg, as the artery is here covered by the superficial layer of muscles; if the operation, however, should be found necessary, it may be performed in the following manner:

Place the limb on the outer side, flexing the knee; make an incision in the middle third of the leg about four inches in length, along and a little behind the inner edge of the tibia; the integuments being divided, the internal saphena vein will be exposed; draw this to the inner side, divide the fascia, and raise the gastrocnemius muscle, and the origin of the soleus from the tibia will now present itself, and should be cut through; in doing this, the aponeurotic attachment of this muscle to the tibia should not be mistaken for the deep fascia; the soleus being raised, and drawn from the bone, the fingers may be passed between the two layers of muscles, and the posterior tibial artery may be felt pulsating beneath the fascia; this being cut through, the aneurism needle is to be passed from without inwards, taking care to avoid the posterior tibial nerve and the venæ comites. From the great depth at which the artery lies, and its proximity to the bone, much difficulty is experienced in effecting this object; so much so, that it has been found necessary to pass a curved needle into the wound, and thus secure the artery; this plan is evidently objectionable, as the nerve may be included with the artery or wounded by the needle. Mr. Guthrie recommends the posterior tibial artery to be tied by cutting through the gastrocnemii muscles from behind.

Between the internal malleolus and os calcis, or a little above this point, the posterior tibial artery is comparatively superficial, and may be tied by making an incision, somewhat semilunar in shape, over the course of the artery, and nearly midway between the two bony eminences mentioned, but a little nearer the ankle. The integuments and fascia, which is here of great strength, having been cut through, the artery will be soon brought into view in company with its nerve and venæ comites. Pass the aneurism needle from behind forwards, to avoid the nerve and secure the vessel.

If above the ankle, the posterior tibial artery may be secured by making a nearly straight incision parallel to and along the inner side of the tendo Achillis. It is in this situation that the posterior tibial artery is secured in cases of wounds of the plantar arteries. As we have elsewhere observed, when either the palmar or plantar arch is wounded, the practice is (not as in other cases of wounded arteries, when the wounded vessel is cut down upon and secured,) to tie the artery leading to the injured vessels, as the cutting into the palm of the hand or the sole of the foot, amongst so many tendons, nerves, and vessels, would most probably be followed by a dangerous inflammation. When the posterior tibial artery is affected with aneurism in the upper third of the leg, the popliteal or femoral artery should be secured. The peroneal artery lies so deep, and is so secured behind the fibula, that it is almost precluded from any interference on the part of the surgeon. Mr. Hey relates a case, in which he sawed out a portion of the fibula in order to tie the vessel; such practice is not to be recommended. Both the posterior tibial and peroneal arteries are frequently injured by spiculæ of bone in fractures of the tibia or fibula. In these cases, if there be no actual wound, the limb becomes distended, and mortification of the leg frequently results. The opinion of the surgeons is divided as to the practice that should be adopted in such cases; some advocate the amputation of the limb, while others contend that the tying of the popliteal or femoral artery may be resorted to. Neither of these operations should be performed where only a moderate quantity of blood is effused, as it may probably be only a branch of one of the arteries of the leg which has been wounded, and not the trunk itself, the effused blood may then become absorbed, and the wound in the vessel closed.

The numerous tendons around the ankle-joint add much to the security of this articulation; thus it is protected behind and towards the inner side by the tendons of the tibialis posticus, flexor communis, and flexor pollicis; and by the tendons of the peronæus longus and brevis, externally, so that dislocation is rendered almost impossible in this direction; secured too in front by the ligaments and the greater width of the astragalus, this articulation enjoys that degree of security which is so necessary to one upon which the whole weight of the body is thrown. The tendons around the articulation, by the yielding of the muscular fibres connected with them, communicate also to it a degree of elasticity, which adds much to the grace and ease of motion, so essential to perfect progression.

PLANTAR REGION, OR SOLE OF THE FOOT.

The integuments covering the sole of the foot are remarkable for their great density and strength, even at the earliest periods of life, particularly in those situations where they are most exposed to pressure, viz., over the heel, the outer side of the foot, and across the articulations between the metatarsus and phalanges. Beneath these a large quantity of dense granulated adipose substance exists, which serves as an elastic cushion to bear off the effects of violent shocks, communicated in active exertion. Fibrous bands pass from the granulated fat which connect it to the plantar aponeurosis: this fat is most abundant where the greatest pressure is exerted on the foot. On removing this the plantar aponeurosis or fascia is brought into view. This is a dense layer of fibrous aponeurotic structure, triangular in shape, which invests the soft parts in the sole of the foot; it arises, narrow but strong posteriorly, from the os calcis, passes forwards, expanding, and near the metatarso-phalangeal articulations divides into five distinct processes, each of which again subdivides into two portions, which pass forward and are implanted into the lateral ligaments of the articulations and the sheaths of the flexor tendons. The plantar aponeurosis sends in septa between the muscles, which are inserted into the under surface of the tarsus and metatarsus, and divide the fascia into three tolerably distinct portions; of these the middle is the strongest and most inferior, the internal is the weakest and most superior. The fibres of the plantar fascia are chiefly longitudinal; but anteriorly some transverse ones exist, which serve the purpose of connecting the longitudinal fibres; its under surface is smooth and glistening, its upper is rough and gives origin to muscular fibres. The use of the plantar aponeurosis is to preserve the arch of the foot, and to protect the soft parts above it from undue pressure.

On removing the plantar fascia, the soft parts in the sole of the foot are exposed. The muscles of this region are divided into four layers; in the first or superficial layer are

Abductor pollicis,
Flexor digitorum brevis,
Abductor minimi digiti.

In the second layer are

Long flexor tendons,
Musculus accessorius,
Lumbricales.

The third layer comprises

Flexor pollicis brevis,
Adductor pollicis,
Transversalis pedis,
Flexor minimi digiti.

The fourth layer consists of the

Interossei muscles,
Peronæus longus tendon.

These muscles are also divided into three compartments, an internal, middle, and external, by the plantar fascia.

The different muscles and tendons in the sole of the foot, from their oblique direction and decussating with each other, assist in preserving the arches of the foot and keeping the bones in their proper position. By the elasticity, too, which they communicate to the parts, the foot enjoys that degree of alternate yielding and resistance which render it so well adapted to support the weight of the body, and prevent shocks, as in leaping, running, &c., from being transmitted upwards to the brain and spinal marrow, so likely to be injured by any violent commotion of the body.

END OF PART I.

PART II.

SURGERY.

MANUAL
FOR
THE COLLEGE OF SURGEONS.

SURGERY.

ON INFLAMMATION.

Inflammation is an altered action in the vessels of a part, commonly attended with redness, pain, heat, and swelling, and with more or less constitutional disturbance.

The *Redness* is caused by a greater quantity of blood being sent to the part, occasioned by the increased action of the arteries; and in some situations, as in the conjunctiva, by the dilated vessels allowing of the circulation of an increased number of the red globules of the blood, where it was formerly the opinion that they (the red globules) had no passage.

Pain is caused by an increased degree of sensibility in the nerves of the part, either from their participating in the inflammation, or from the distended adjacent parts compressing the nervous filaments.

Heat. On applying the thermometer to an inflamed part, the temperature is found to be a few degrees higher than in the healthy parts of the same body. This is produced by the greater quantity of arterial blood circulating in that part. This increase of temperature is not so great as is frequently imagined, being seldom more than one or two degrees. Mr. Hunter has proved this fact, by introducing the thermometer into inflamed wounds. In the case of inflammation after the operation for hydrocele, the mercury rose to 101°. Although we cannot demonstrate an increase of temperature in inflammation of internal organs, yet we conclude that such is the case, from the feelings of the patient, and the result of experiments on external parts when inflamed.

The *Swelling* is caused by the increased quantity of blood sent to the part, and also by an effusion of serum into the cellular tissue.

These local symptoms are usually attended with a disturbed state of the constitution, which is called fever, and which may be considered as the inflammation of the constitution. This is characterized, when well marked, by a full strong pulse, hot skin, furred tongue, constipated bowels, thirst, and some disturbance of the sensorium.

Although such are the usual symptoms of inflammation, it must be recollected that these are much modified by the peculiar nature of the inflammation, the structure of the parts affected, the age, sex, and constitution of the patient; all of which circumstances not only alter the features of the inflammatory action, but influence its termination, and cause us to modify or vary the treatment to be pursued: thus, in erythematous inflammation of the skin, there is but little swelling, as is also the case when the inflammation exists beneath a resisting fibrous structure, as in cases of deep-seated paronychia; in inflammation of deep-seated organs, there is seldom any redness apparent externally. Inflammation in the young subject, in general, runs more rapidly to its terminations than in the old, in which all the actions are more languid.

Inflammation terminates in *Resolution*, *Adhesion*, *Suppuration*, *Ulceration*, and *Mortification*.

Resolution. This is the subsidence of the inflammatory action, without the production of any visible morbid change in the structure of the parts. Resolution is that termination of inflammation which is most to be desired, especially where the organs affected are those in which any morbid deposit is either detrimental to life or injurious to the function of the part affected. Thus we should especially endeavour to obtain it in inflammations of the brain, thoracic and abdominal viscera, the eye, &c., as any morbid alteration there will either suspend or materially interfere with the functions of these parts.

Adhesion is caused by the effusion of coagulable lymph from the vessels of the part, which lymph afterwards becomes organized or is absorbed. This termination of inflammation is generally desired in cases of wounds, either produced by accident or by the knife of the surgeon. When a wound has been inflicted, and it is desirable to unite it as soon, and with as little injury to the constitution, as is possible, union by adhesion, or by the *first intention* is promoted. For this purpose the wound is cleared of all foreign matter, and the edges brought together: in a few hours inflammation takes place, and lymph is poured out, which glues the edges of the wound together: in the course of a few hours more, vessels shoot into the coagulable lymph, which thus becomes organized, and completes the adhesion. Mr. Hunter conceived that wounds are sometimes united by the fibrine of the blood, without any inflammatory action: this opinion is not at present received. Adhesions frequently form without wounds, as in inflammation of serous membranes. The time for the completion of the process of adhesion is variable; in some cases it is perfected in from six to twelve hours, in others it requires some days for its completion.

Suppuration. In this termination of inflammation, a fluid named pus is formed from the minute vessels of the part. Pus is a fluid of a whitish yellow colour, of the consistence of cream, of a mawkish taste, and is inodorous. It is composed of minute globules, floating in a thin transparent fluid. It sinks in water, and will not readily unite with it. It is coagulable by a solution of the muriate of ammonia; forms a soapy fluid with the fixed alkalies; a gelatinous compound with ammonia. Purulent matter is more easily secreted by mucous than other surfaces. The secretion from them when inflamed is first thin and watery, and then resembles mucus, and finally becomes purulent. When pus is secreted in the interior of the body, it is usually contained in a bag or cyst. This is formed by the effusion of lymph, which is poured into and condenses the surrounding cellular tissue. The collection of matter thus formed is termed an *abscess,* and is called *acute*, to distinguish it from those *chronic abscesses*, or collections of matter, which form without much inflammation, and generally in connexion with diseased vertebræ. In these a cyst is either wholly wanting or is imperfectly marked. A suppurating surface generally presents a granulated appearance, and indeed it would appear that an approach to this condition is essential to the formation of pus, as all structures assume it before purulent matter is formed. The formation of pus in large quantities is generally, but not always, attended with a peculiar inflammatory state of the constitution, named *hectic fever*. This is characterized by a frequent weak pulse, flushings of the face, the hands, or the feet, profuse night sweats or diarrhœa. It is also accompanied with exacerbations of fever, of an intermittent character. These exacerbations occur at mid-day and towards evening; the latter is the better marked; the attack is characterized by a great rapidity of the pulse and rigors, followed by a hot fit and sweating, which last for some hours.

Ulceration. The term ulceration is not confined to that process by which ulcers are formed on the external surface of the body, but comprises also the term *ulcerative absorption;* the removal of different parts of the body, as of the vertebræ, from the pressure of an aneurismal tumour; the separation of a mortified or dead part from the living, as in exfoliation of bone; and the progress of an abscess or collection of matter from the internal to the external surface of the body. The absorbents are said to be the chief agents in producing ulceration, their action being excited generally by pressure. The existence of matter is not necessary to the ulcerative process, as is seen in the removal of the vertebræ, from the pressure of an aneurismal tumour. This process tends generally to the surface; by this means an abscess, although formed deep, makes its way outwards, and finally bursts through the skin. The effusion of lymph preceding the ulcerative process, prevents the escape of the matter before it has arrived at the integuments. In this way, aneurismal tumours, foreign bodies, such as musket-balls, splinters of bone, &c., come to the surface, and are ultimately discharged. When ulceration takes place on the surface of the body, the part soon becomes covered with reddish, conical, fleshy bodies, named *granulations;* these are formed from lymph, which is effused from the open surface, and subsequently becomes organized. This granulated surface generally secretes pus, and is called an ulcer.

The ulcerative process is most active in the more highly organized parts, as is seen in the separation of a mortified limb, in which the skin and muscles are soon separated, whilst the bones and fibrous structures are but slowly removed.

Mortification is the last termination of inflammation. It takes place most readily in feebly organized parts, as in bones, cellular membrane, and fasciæ. It is caused by the inflammatory action being too violent for the vital process of the part, and this may be induced wherever the balance between these is destroyed, whether this results from the severity of the inflammation or from the weakness of the parts affected.

The *Treatment* of *Inflammation* is best regulated by the antiphlogistic regimen. This consists in the general abstraction of blood by opening one of the veins or smaller arteries, local bleeding by means of cupping, leeches, &c., fomentations, purgatives, diaphoretics, the use of mercury, a spare diet, and cooling drinks. The extent to which these remedies are to be carried must be regulated by the character of the inflammation, its seat, nature, and the peculiarities of the patient, as will be found laid down in the consideration of the different diseases here treated of.

The preceding description refers chiefly to that form of inflammation, termed *acute* or *phlegmonous* inflammation. There is another form of inflammation, termed *chronic*, which is different in its symptoms, and requires a modified plan of treatment. In this, the apparently increased vascularity is less than in the acute form, the vessels being of a pale red colour; the pain is more of a dull heavy character, and the temperature is but little raised. The swelling is the only symptom as well marked in this as in the acute inflammation. The treatment consists in the moderate abstraction of blood, and the use of gently stimulating applications to the part, which have the effect of increasing the tone of the vessels. Cold applications are to be preferred to warm, in this form of inflammation, as the latter cause a relaxation of the vessels of the inflamed part, and thereby conduce to the continuation of the disease.

We have said that the symptoms and results of inflammation are much modified by the structure of the parts affected: the following are examples of this fact.

When inflammation is seated in the *skin*, it usually becomes extensive, because the surface is unbroken. Its colour is very florid, it separates the cuticle in the form of vesications, which usually contain serum, but also in some cases, fibrine; a serous effusion is also produced by it into the subjacent cellular tissue.

In the *cellular membrane*, inflammation produces an effusion, which obliterates or fills its cells; if it proceed, it occasions suppuration and produces an abscess. In still more violent forms, the cellular membrane sloughs, as in phlegmonous erysipelas. Inflammation of *fasciæ* is generally extensive, from the large surfaces they present. When matter forms beneath them, it should be let out immediately to relieve the sufferings of the patient, and prevent the sloughing of these structures. Inflammation of *muscles* is known by the spasmodic twitchings which attend it. *Tendons* are not prone to inflammation; when inflamed they frequently perish, and are cast off from the fleshy part of the muscle.

Arteries are rarely inflamed, except after wounds on the application of ligatures. When the lining membrane becomes inflamed, it sometimes extends as far as the cavities of the heart. The large *veins* are very liable to an erysipelatous inflammation of their lining membrane. When inflamed, the veins become like hard and broad cords, and are extremely tender to the touch. Abscesses form in the course of the inflamed veins, both external to them and in their interior. The inflammation spreads rapidly towards the heart, and also in the contrary direction.

Inflammation of *nerves* is exceedingly painful, and sometimes extends towards the spinal marrow or brain. Inflammation in the *absorbents* is marked by red lines on the skin in the course of these vessels. These form hard knots from the skin participating in the inflammation. The absorbent *glands* become also inflamed, and both glands and nerves occasionally suppurate. *Serous* membranes, when inflamed, are prone to the effusion of lymph, causing adhesion: they seldom suppurate. *Mucous* membranes, on the contrary, suppurate rapidly.

The preceding forms of inflammation are named *common*, to distinguish them from those which depend on a specific disease in the constitution, or part affected, and which are therefore named *specific*. The *syphilitic*, *scrofulous* inflammations, &c. are instances of this, and will be considered under the heads of syphilis, scrofula, &c.

ON ULCERS.

An *Ulcer* is a solution of continuity in any of the soft parts of the body, attended with a secretion of pus, or some kind of discharge, and presenting generally a granulating surface. Ulcers are divided into the *local* and *constitutional*, according as they are produced by a local or constitutional affection; also into the simple and specific, the former being unaccompanied by any peculiar action of the part or constitution, the latter being caused by the presence of such action. Sir E. Home's classification of ulcers is that most approved of; he divides them as follows:

1. Ulcers in parts which have sufficient strength to carry on the actions necessary for their recovery,—e. g. *Simple*, *purulent*, or *healthy* ulcers.

2. Ulcers in parts, which are too weak for that purpose—*Weak* ulcers.

3. Ulcers in parts, whose actions are too violent to form healthy granulations, whether this arise from the state of the parts or of the constitution—*Irritable*, *Gangrenous*, or *Sloughing* ulcers.

4. Ulcers in parts, whose actions are too indolent, whether this arise from the state of the parts or of the constitution—*Indolent* ulcers.

5. Ulcers in parts which have acquired some specific action, either from a diseased state of the parts or of the constitution—*Syphilitic scrofulous* ulcers, &c.

6. Ulcers in parts which are prevented from healing by a varicose state of the superficial veins of the upper part of the limb—*Varicose* ulcers.

Simple, *purulent*, or *healthy* ulcers. Characters: The granulations are small, numerous, conical, and of a bright florid red colour, and rise a little above the surrounding edge. The discharge is healthy pus, of a white colour, thick consistence, readily separates from the surface of the sore, and is composed of small globules, swimming in a transparent fluid. *Applications:* Dry lint, simple ointment, Lotio nigra, Lot. Sulph. Zinci, Lot. Sulph. Cupri.

Weak Ulcers. Characters: The granulations are large, round, but of a soft texture, and present a glossy semi-transparent appearance. The granulations frequently rise above the level of the surrounding skin, and are sometimes suddenly absorbed. *Applications:* Ung. Hyd-nitrico-oxydi, Ung. Hyd-fort, Lotio Sulph. Zinci, Lot. Sulph. Cupri, Lotio flava, Liquor Calcis, Lotio Calcis Chlorinatæ, Adhesive straps and roller.

Irritable, *Gangrenous*, or *Sloughing* ulcers. Characters: This ulcer is generally circular in shape. The margin of the surrounding skin is jagged, and either terminates in an edge that is sharp and undefined, or presents a well-marked defined edge, having a nibbled appearance. The bottom of the ulcer is irregular, and does not present granulations, but is covered with a whitish spongy substance, and frequently presents a number of bloody spots. The discharge is thin and ichorous. Everything that touches the sore gives pain, and commonly makes it bleed. The pain is very severe, and liable to exacerbations. When irritable ulcers partake of the gangrenous or sloughing character, repeated sloughs form, preceded by an increase in the painful symptoms, until the sore assumes a large size. *Applications:* These ulcers are treated either by soothing remedies or by caustics. The former act by lessening the inflammation, the latter destroy the surface of the sore and bring the inflammation to a termination by the formation of a slough. *Soothing remedies:* Poultices, Warm fomentations, Leeches to surrounding skin, Water-dressing, Lotio nigra, Opiate solutions, Liquor plumbi, di-acetatis dilutus. *Caustic applications:* Nitric. Acid., Chloridum Antimonii, Liquor Potassæ Arsenitis, Actual Cautery. The Lotio Nit. Argenti, Lot. Acid. Nit. and Lotio flava, will also be useful in some conditions of these ulcers.

Indolent Ulcers. Characters: The edges of the surrounding skin are thick, prominent, smooth, and rounded. The surface of the granulations is smooth and glassy. The pus is thin and watery, being composed of a mixture of pus and coagulable lymph. The lymph consists of flakes which cannot be easily separated from the surface of the sore. The bottom of the ulcer is nearly level, and is slightly depressed below the level of the surrounding skin. Indolent ulcers do not readily form granulations, although these sometimes become superabundant and of a fungous character, and are often absorbed again in a few hours. *Applications:* Stimulating applications are found most useful in this form of ulcer. Should the edge of the ulcer become callous, it may be destroyed by caustic or removed with the knife. The adhesive straps and roller, as recommended by Mr. Baynton, will also be found beneficial.

Specific Ulcers. These depend on some specific action in the part, which is the consequence either of a specific disease in the constitution, or the direct application of a specific poison. They are considered under the heads of Cancer, Syphilis, Scrofula, &c.

Varicose ulcers are described with varicose veins.—In the treatment of all ulcers, it is particularly necessary to attend to the general health of the patient, as this frequently prevents our local applications from having a beneficial effect on the sore; for, as soon as the state of the constitution is improved, the ulcer rapidly heals without any change in the local remedies. Many ulcers, not of a venereal character, will be made to heal by the internal use of mercury. Position, too, is found to have much effect on the healing of ulcers: thus, if they be situated on the lower extremity, the patient should keep the limb as much as possible in the horizontal position; this not only relaxes the muscles of the part, but also favours the return of the venous blood.

Ulcers are *formed* either from a destruction of the skin, as in cases of injury, or from the gradual absorption of the skin, as in the bursting of an abscess. The open surface inflames, throws out coagulable lymph, this soon becomes organized and forms granulations. Some assert that the granulations are found beneath the layer of lymph, which becomes absorbed by them. Ulcers *heal* by cicatrization; in this process the granulations coalesce and contract the size of the ulcer; new skin is then formed by the deposit of lymph, generally from the circumference to the centre of the sore. The rete mucosum is not formed for some time after the healing of the ulcer. The cicatrix is at first more vascular than the natural skin, but afterwards becomes less, and frequently presents a callous surface.

Noli me tangere or Lupus is a peculiar ulceration of the glands or follicles of the nose, those small cavities which secrete the sebaceous matter; the ulceration extending deeply, at last even the cartilages of the nose become destroyed. *Application:* The following ointment spread on lint should be laid on the ulcer, and left there for twenty-four hours; when removed, a slough will come away: the ulcer should now be dressed with simple ointment, when it will generally heal: ℞. Arsenic. Oxyd., Sulph. flavi., āā ʒj, Ung. Cetacei, ℥j., Ft. Unguentum. In more superficial cases, the Lotio Nitratis Argenti and Lotio nigra will be found useful; as also leeches, and the occasional application of the bread and water poultice. Some cases of Noli me tangere are very intractable, and cause much deformity before they heal.

ON MORTIFICATION.

Mortification is divided into *gangrene* and *sphacelus*. *Gangrene* is that condition of the part in which some vitality still remains. *Sphacelus*, on the contrary, is complete death.

Mortification is also divided into the *moist* and *dry*. The *moist* gangrene is that which is preceded by inflammation, and is also named the *inflammatory* or *acute* gangrene. *Dry*, also called *chronic* or *idiopathic* gangrene, is that which takes place without any visible inflammatory action having preceded it. The term *dry* gangrene is not strictly correct, as any gangrene may be made to present a moist appearance by preventing the evaporation from the mortified part.

The most frequent causes of gangrene are violent inflammation, erysipelas, severe contusions, burns, cold, pressure, deficient circulation of blood or nervous energy, a diseased state of the blood-vessels, attended with debility of the constitution, improper food.

The best example of gangrene proceeding from inflammation is that which results from a compound fracture, *e. g.* of the leg. The gangrene usually appears on the third or fourth day after the receipt of the injury. The first symptoms are those of violent local and constitutional inflammation, which disappear on the occurrence of the mortification. The parts now, from being painful, lose all sensibility and become cold, the redness disappears and is replaced by an irregular dark colour of the skin, known as an ash colour; in some places this approaches to a black colour, in others is of a dark brown hue. Vesications appear on that part, and are formed by effusion of serum beneath the cuticle; they are irregular in shape and size, can be easily dispersed by pressure, and contain a darkish-coloured serum; the limb becomes much swollen, the cellular tissue being filled with air, and presents an emphysematous feel. If a wound be present the discharge is dried up, or consists of a thin, ichorous, offensive matter, mixed with bubbles of air. The constitution sympathises with this local change, the inflammatory fever disappears, and is succeeded by a great languor and debility. The skin is covered with a cold, clammy perspiration, the pulse is quick and irregular, often intermitting; the stomach is irritable, and the bowels become relaxed. Hiccough supervenes. The patient's countenance indicates the great local and constitutional disturbance present; the features are collapsed, the eyes sunk, and the angles of the mouth drawn backwards and downwards. Delirium of a low muttering nature is often present. The constitutional symptoms are not always so severe; they depend on the extent of the mortification, the part affected, and the previous health of the patient.

The *treatment* of mortification consists in expediting the separation of the mortified parts, supporting the constitution at the same time; and when this cannot be accomplished, the removal of the limb, if practicable and not contra-indicated by a too debilitated state of the constitution. The fermenting poultice is the most effectual means for causing the separation of the mortified parts. The lotio acidi nitrici, the carrot, charcoal, and port-wine poultices are also used with the same object. As internal remedies, bark, wine, and opium will be found most beneficial.

Erysipelas is frequently followed by gangrene. The appearances present are similar to those just described. The treatment is also similar. Mortification resulting directly from severe contusion is not attended with much constitutional disturbance. It is a completely local affection, the contusion at once destroying the vitality of the part. Burns produce mortification also by the almost immediate destruction of the vitality of the parts. Here the constitutional symptoms are chiefly influenced by the extent of surface destroyed and its contiguity to vital organs. Mortification from exposure to severe cold is remarkable from the little pain generally preceding the gangrene, the exposed parts having frequently perished without the patient being at all aware of the circumstance. In some cases a good deal of pain precedes the mortification. Larrey gives the following account of some cases of mortification that occurred in the French army during the Russian campaign: "Many soldiers complained of acute pain in the feet, and of numbness, heaviness, and prickings in the extremities. The parts were scarcely swollen, and of a dull red colour. In some cases a slight redness was perceptible about the base of the toes and on the back of the foot. In others, the toes were destitute of motion, sensibility, and warmth, being already black, and as it were dried." Cold without moisture is not so likely to produce mortification as when combined with this last-mentioned agent. Parts exposed to a severe degree of cold should be first rubbed with snow, or with the bare hand, apart from artificial heat; after which a greater degree of warmth, gradually increased, may be applied. Mortification arising from long continued pressure, as in patients labouring under chronic diseases, and obliged to be in one position for a length of time, is chiefly attributable to debility, and the pressure that the parts sustain obstructing the circulation. The gangrene usually appears over bony surfaces, as over the sacrum, trochanter, os ilium, scapula, &c. The part always, at first, becomes soft, of a livid red colour at the circumference, and œdematous, afterwards losing its sensibility and acquiring a black appearance; at length it is converted into a foul sloughing ulcer. Examples of mortification, arising from a deficient supply of blood, are met with where a ligature has been applied round a polypus or other tumour, or in cases of wounds of the principal vessels of a limb, or where the main artery has been tied, as for the cure of aneurism. In these latter cases the mortification appears first near the extremity of the limb, from which it ascends slowly to the part where the circulation is arrested. Amputation above the joint becomes necessary under such circumstances. A deficiency of nervous energy in a part predisposes to, if it do not produce, gangrene. Injuries of the spine frequently present examples of this fact.

Mortification may be produced by a diseased state of the blood-vessels, attended with debility of the constitution. This form of mortification is that usually known by the name of dry or Pott's gangrene. It almost always occurs in advanced life, most frequently in the lower extremities, and oftener in males than females. In some few instances the disease makes its appearance with little or no pain, but in the majority of cases the patient feels great uneasiness through the whole foot and ankle-joint, particularly at night. This is, after some time, succeeded by the formation of a small discoloured spot on the inside, or at the extremity of one of the smaller toes; from this spot the cuticle is always found detached, by forming a vesication, and the skin underneath of a dark red colour. In some patients the disease is slow and long in passing from toe to toe, and from thence to the foot and ankle; in others its progress is more rapid and exceedingly painful. Its course is preceded by a dark red appearance of the skin. As the parts mortify, they become dry and hard, from the evaporation of the fluids. The constitutional symptoms are those of debility, there is great want of sleep, and in general low muttering delirium.

The *treatment* consists in the exhibition of bark and opium internally, and the free use of wine. The parts should be covered with folds of lint, moistened with camphorated spirits of wine, and the limb wrapped in cotton. But little can be done with local or indeed with constitutional remedies. Leeches have been recommended of late, on the supposition that inflammation of the arteries is the principal cause of the disease.

In most cases, the disease spreads upwards along the limb, and the patient sinks, before any attempt is made to arrest the mortification and throw off the gangrened parts. In some, a line of demarcation forms, and the mortified portion is separated from the living. The first appearance of a line of demarcation is indicated by the parts above the dark red colour, just alluded to as indicating the spread of the gangrene, presenting a bright healthy red colour; where the two colours touch the line of demarcation is found. At first, the distinction between them is not very apparent, but soon becomes sufficiently manifest. Absorption now begins to take place in the skin, on which a line of ulceration is soon formed. This proceeds deeper and deeper until the whole limb is removed. This is, indeed, the process observed by nature in throwing off all mortified parts. The most highly organized parts are the most rapidly separated; thus, the skin, muscles, and blood-vessels, are sooner detached than the fascia, ligaments, and bones; these are the last to be detached, not separating, in some cases, for many weeks, and often requiring the interference of the surgeon, who removes them with the saw, to get rid of the offensive mass. The separation of the parts is accomplished by the action of the absorbents, which act on and remove the living from the dead structures. There is no hæmorrhage from the vessels during the separation of the mortified parts, as the vessels are filled with a coagulum up to the next anastomosing branch, as in cases in which they are tied before the absorbents begin to act upon them. Amputation should never be performed, in this species of gangrene, before the line of demarcation is formed, as we know not to what extent the disease may spread; and if performed, gangrene will most probably attack the stump, if the patient should not sink from the effect of the operation. The arteries leading to the gangrened parts are generally found in a diseased condition, and not unfrequently converted into bone.

Improper food sometimes gives rise to mortification. The best example of this is to be found in cases where the ergot of rye has been used.

Cancrum Oris. This is a mortification of the cheek, which appears generally in children before the age of six or seven, whose constitutions have been injured by improper diet and bad air, or who have suffered from mercury. It is usually preceded by ulceration and hemorrhage from the gums. The gangrene in general appears near the centre of the cheek, in the form of a dark livid red and somewhat firm tumour. This soon becomes black, when the mortification spreads, so as to destroy the cheek, and expose the gums and teeth. *Treatment:* The nitric acid, or muriate of antimony, should be applied to the edges of the sore, and the patient supported by nourishing food and stimulating medicines. It is usually fatal.

Hospital Gangrene, *Phagedæna Gangrenosa.* This is a form of gangrene which attacks open wounds or ulcers, and is named from its appearing most frequently in hospitals which are much crowded and ill ventilated. Its symptoms and treatment are the same as those mentioned when treating of mortification in general. Its principal characters are, the rapidity with which it spreads from one patient to another, and the successive sloughs which form in the course of the disease. *Treatment:* When the patient is strong and plethoric, and the gangrene has been preceded by marked symptoms of inflammation, the antiphlogistic plan may be resorted to; when such has not been the case, the nitric acid, muriate of antimony, or the liquor arsenicalis applied to the sore, will be found most useful.

Carbuncle or *Anthrax* is a tumour, formed by gangrene of the subcutaneous cellular tissue, which generally appears in originally strong but impaired constitutions. The usual situation for anthrax is the dorsum of the neck or trunk, but it may appear in any other part of the body, where the cellular tissue is abundant. *Symptoms:* When carbuncle is about to take place in any part it is generally preceded by pain, of a burning character; a swelling succeeds of considerable hardness,—this is occasioned by the adhesive inflammation; the surface of the tumour then assumes a livid redness, of a spongy soft feel; little ulcers now form in the skin, which, from their number, give it a sieve-like appearance, so numerous are their orifices; from these a white discharge passes, resembling flour and water mixed together. When the little openings form into one, the dead cellular membrane begins to escape. *Treatment:* Make a crucial incision through and down to the bottom of the tumour, applying the fermenting poultices until the sloughs have separated, and support the patient's strength with stimulants. Carbuncle is seldom fatal, except when it appears on or near the head. In some cases it terminates fatally, when the tumour is large and situated over the thoracic or abdominal cavities.

Furuncle or *Boil* is a circumscribed, very prominent, hard, dark red, painful, inflammatory swelling, of a conical shape, having its base below the skin, and its apex above it. The colour inclines to purple, and on its summit is a whitish little eschar, under which is a mass of destroyed cellular membrane, called a core. If a furuncle or boil be left to itself the eschar on its summit separates, a slough of cellular membrane, with some purulent matter, is discharged, when the sore heals. The *treatment* of boils consists in the application of an emollient poultice, and the paying attention to the state of the stomach and bowels. If a boil be large and painful, an incision may be made through it with the point of a lancet; but, generally speaking, these tumours should not be interfered with. Boils differ from carbuncles in their being numerous and disposed over the body and extremities, being conical in shape, and seldom larger than a pigeon's egg: there is but one slough of the cellular membrane which is discharged by one aperture.

ON INJURIES OF THE HEAD.

Injuries of the head are divided into those which affect, 1st, the scalp; 2d, the bones of the skull; 3d, the contained organs; and 4th, those in which all these parts are engaged.

Wounds of the scalp comprise the simple incised, contused, lacerated, and punctured.

Simple incised wounds of the scalp are treated as in other regions of the body, the part having been previously shaved, the edges of the wound are brought together and retained in apposition by means of adhesive plaster and sutures. There is frequently some difficulty in restraining hæmorrhage from wounds of the scalp, from the retraction of the mouths of the blood-vessels. Pressure, by means of compresses, held for some time over the course of the artery will be often found sufficient; should this not succeed, the vessels must be secured with the ligature. The use of sutures in the scalp is objectionable, as they are productive of irritation, and may induce erysipelas.

Contused wounds of the scalp are in general accompanied with a certain degree of laceration, we shall therefore consider them under the head of contused and lacerated wounds. These injuries are produced by blows of some blunt instrument on the head, or by the passage of a wheel across part of the skull; in this way it frequently happens that a large portion of the scalp is separated, which hangs down, forming a large flap, on the side of the head. The exposed parts should be cleared of all foreign bodies, such as dirt, gravel, &c. and the flap immediately replaced *in sitû*, being held so by strips of adhesive plaster, with one or two points of suture, if these should be found necessary. A bandage is now to be applied, and the head kept cool by the use of cold evaporating lotions. The antiphlogistic regimen is to be observed to prevent the inflammatory symptoms so likely to ensue. The old practice of cutting away the flap, or any portion of it, cannot be too highly reprobated. In some cases, the flap may be so contused as to afford little hope of its retaining its vitality; even here, it is better to trust to nature than have recourse to the knife. In favorable cases, the edges of the wound unite in the course of four or five days, by the first intention, and the patient recovers without a single bad symptom. Generally speaking, a slight suppuration takes place in some portions of the wound, caused by the presence of some extraneous substance, which, being discharged, the parts unite by granulation. Collections of matter also sometimes form beneath the flap, caused by a portion of dirt or gravel remaining; these, if near the edge of the wound, may be discharged, by opening with a probe the nearest point of the wound; or, if this be not convenient, by making an opening into the abscess with a lancet.

These extensive wounds of the scalp are however frequently followed by alarming symptoms, such as inflammation of the scalp, erysipelas, inflammation of the membranes of the brain and brain itself, and exfoliation of the bone.

Inflammation of the Scalp commences within twenty-four hours after the receipt of the injury. The scalp becomes swollen, hot, and tender to the touch, and a thin ichorous discharge issues from the wound. Febrile symptoms appear at the same time; the pulse becomes quick, full, and strong, the skin hot, the tongue furred, the bowels confined, and the urine scanty and high-coloured. There is also loss of appetite, thirst, and frequently a disturbed state of the sensorium. Leeches and fomentations should be applied to the head, and the wound covered with an emollient poultice, one or two straps of adhesive plaster being left to retain the parts in apposition. Blood may be taken from the arm, and the bowels freely opened by means of calomel, followed by saline aperients, and these succeeded by the use of diaphoretic medicines. By these means the inflammation is generally subdued. *Erysipelas* usually appears about the third or fourth day, and spreads over the face and neck.

Inflammation of the Membranes of the Brain (*Meningitis*) sets in from the seventh to the tenth or fourteenth day, or even later; indeed the patient is exposed to its attack, as long as any external wound remains; nor is he wholly secure from it after this has healed, the slightest exciting cause is often sufficient to call it into action. "Meningitis, after the receipt of an injury of the head, is usually ushered in by pain in the part which received the blow. This pain soon extends over the head, and is attended with languor or dejection of spirits, which are soon followed by nausea, and inclination to vomit, vertigo, a quick and hard pulse, great intolerance of light and sound, and disturbed or imperfect rest. A day or two after this attack, if no means preventive of inflammation are used, the part stricken generally swells and becomes puffy and tender, but not painful, forming the *puffy tumour*, if no wound be present. The tumour does not rise to any considerable height nor spread to any great extent. If this tumid part of the scalp be now divided, the pericranium will be found of a darkish hue, and either quite detached or very easily separable from the skull, between which and it will be found a small quantity of dark coloured ichor. If the disorder has made such progress that the pericranium is quite separated and detached from the skull, the latter will, even now, be found to be somewhat altered in colour from a sound healthy bone. From this time the fever generally increases, the skin becomes hotter, the pulse quicker and harder, the sleep more disturbed, the anxiety and restlessness more fatiguing, and to these are generally added irregular rigors, which are not followed by critical sweat, and which, instead of relieving the patient, add considerably to his suffering. If the scalp has not been divided or removed until the symptoms are thus far advanced, the alteration of the colour of the bone will be found to be more remarkable, it will be found to be whiter and more dry than a healthy one, and more like a dead bone ; the sanies or fluid, between it and the pericranium, will also in this state be found to be more in quantity, and the membrane will have a more livid diseased aspect. In this state of matters, if the dura mater be denuded, it will be found to be detached from the inside of the cranium, to have lost its bright silvery hue, and to be, as it were, smeared over with a kind of mucus, or with matter, but not with blood. Every hour after this period, all the symptoms are exasperated and advance with hasty strides; the headach and thirst become more intense, the strength decreases, the rigors are more frequent, and at last convulsive motions, attended in some with delirium, in others with paralysis, and a comatose stupidity finish the tragedy. If the scalp be now divided, a very offensive discoloured kind of fluid will be found lying on the bare cranium, the appearance of which will be still more unlike to the healthy natural one; if the bone be now perforated, matter will be found between it and the dura mater, generally in considerable quantity, but variable. Matter may also be met with in the arachnoid sac, on the surface, or in the substance of the brain. Where the scalp has been wounded, the wound, although previously proceeding favorably, loses its florid complexion and granulated surfaces, becomes pale, glassy, and flabby, and discharges a thin coloured sanies; the lint with which it is dressed sticks to it, and the pericranium, instead of adhering firmly to the bone, separates from it all around to some distance from the edges." Mr. Pott conceived that the puffy tumour always indicated a separation of the dura mater from the internal surface of the cranium; such however, is not the case in every instance. When symptoms of compression make their appearance, the operation of trephining becomes necessary, in order to afford exit to the matter lodged between the bone and the dura mater; as, however, the matter is frequently lodged in the arachnoid sac, or the surface, or in the substance of the brain, but little success has followed the operation. The puncturing of the dura mater has been occasionally practised, but with little benefit, as the matter when formed gravitates to the base of the brain.

The *Treatment* of meningitis, in the early stages, consists in the free abstraction of blood, both locally and constitutionally, the use of cold applications to the head, and the administration of active purgative medicines. If these remedies should not avail in controlling the inflammation, the patient should be brought as rapidly as possible under the influence of mercury. In the more advanced stages, where matter has been formed, medicines have but little effect.

Exfoliation of the bone is an exceedingly tedious process. It is caused by the destruction of the external or internal periosteum or both. In the former instance the outer table of the skull perishes, and is thrown off by the absorbents acting on the living parts, so as to detach the deadened portion; this becomes loose and drops off, or is removed by the surgeon; granulations now appear from the diploë, which, uniting with those of the external wound, complete the cure. When the internal periosteum, or dura mater, has been detached, the whole substance of the bone is more likely to perish; in this instance, the process of separation is still more tedious and dangerous to the patient. The external periosteum may be destroyed, to a small extent, without the bone perishing, as this is most nourished from the internal periosteum. Blows on the head frequently cause a separation of the dura mater from the internal surface of the cranium, without producing any external appearance. The injury may manifest itself only on the supervention of meningitis, and the formation of matter between the bone and dura mater.

Punctured wounds of the scalp, in which the tendinous expansion of the occipito-frontalis muscle is engaged, are often followed by violent symptoms, resembling those of meningitis, and caused by an inflammation beneath the tendinous expansion, followed by the formation of matter. When such symptoms make their appearance an incision should be made in the course of the wound, and through the aponeurosis: this will relieve the symptoms almost immediately. The wound should be covered with an emollient poultice, and the antiphlogistic regimen observed. When the inflammation has subsided the wound may be dressed.

Blows on the head, in which the scalp is not wounded, are frequently followed by the formation of a bloody tumour. This appears immediately after the receipt of the injury, and is caused by the rupture of some of the subcutaneous vessels, which force out the blood into the cellular tissue, between the pericranium and periosteum. On examining the tumour, the finger sinks into its centre, whilst its circumference is hard and resisting. This appearance, which is caused by the blood being coagulated in the circumference where the cells of the cellular substance are not ruptured, whilst it is fluid in the centre, has been mistaken for a depressed fracture of the skull. It may be distinguished by passing the fingers along the scalp; on arriving at the circumference of the bloody tumour, the fingers are first elevated and then sink in the centre; whereas, in the depressed fracture, the fingers at once pass into the depression. The *Treatment* of the bloody tumour consists in the application of cold evaporating lotions, in order to cause its removal by the action of the absorbents. Should these be found insufficient, pressure, or the use of blisters, may be resorted to. Opening of such tumours is justifiable where inflammation has attacked them, and matter has formed. A puncture may now be made into them, and their contents given exit to. Opening of them at an earlier period is likely to be followed by inflammation of the periosteum, death of the bone, and in many cases may be followed by disease of the brain itself.

Injuries of the Bones of the Cranium. The bones of the skull, like all other bones, are subject to fracture, either simple or compound. A simple fracture of the skull, without any displacement of the bones, is usually called a fissure. The most useful division of the fractures of the skull, is into, 1st, "those in which the fractured bones are not depressed;" and, 2d, "those in which they are depressed below the level of the surrounding bones."

There are no symptoms peculiar to a simple fracture of the skull, unattended with depression, nor is there any peculiar plan of treatment required for them. Should symptoms of inflammation appear, they are to be treated as already laid down in treating of meningitis. No surgeon is justified in cutting through the scalp in order to ascertain whether a fracture exists or not, as in so doing, if there be a fracture, he converts it from a simple into a compound one; and if there be not, a wound is made unnecessarily in the scalp. Indeed all fractures of the skull are to be treated with reference only to their immediate or remote influence on the brain and its membranes; where these do not become implicated, the fracture is left almost wholly to nature, no surgeon, now-a-days, thinking it necessary to remove a portion of the skull in order to *prevent* inflammation of the brain or dura mater.

Compound fractures of the skull are treated on the principles laid down in treating of compound fractures generally. Where a fracture of the skull, whether simple or compound, is attended with depression, the case is altered; here is a certain injury to the brain, consisting of more or less pressure upon it, and frequently a wound of it or one of its investing membranes. A depressed fracture is generally, but not always, accompanied with symptoms of compression of the brain, which are more or less violent, according to the degree of depression of the bone. In some cases, where the depression is moderate, the symptoms of compression are very mild,* and may last but for a short time, as the brain may either force upwards the displaced bones, or will accommodate itself, and especially in children, to the altered condition of the cranium.

Fractures of the outer wall of the frontal sinus in which the internal plate of the bone is depressed into the cavity should not be mistaken for a fracture of the whole of the bone.

When then we meet with a depressed fracture, accompanied with symptoms of compression, our attention is to be directed to the relief or removal of the latter. Where a wound exposes the fracture, it is well to raise the bone at once, even if no symptoms of compression be present, as insanity or epilepsy may result from the depression if allowed to remain: no injury is done to the parts by raising the bone. The treatment next to be pursued consists in the application of leeches to the head, and the abstraction of sixteen or eighteen ounces of blood from the arm in the adult, followed by the use of purgative medicines. By these means the quantity of blood circulating in the brain is diminished, and this organ is enabled to accommodate itself to the diminished cavity of the cranium, and at the same time the setting in of inflammatory symptoms is guarded against. Should the symptoms of compression continue unrelieved, or become increased, after the use of these remedies, we are obliged to proceed to the elevation of the depressed portion of bone. If the scalp has not been wounded, we make an incision into it so as to expose the fracture. This being done, the bone is raised by introducing the point of the elevator, or other instrument, under its depressed margin to a level with the surrounding bone. It frequently happens that this cannot be accomplished, in consequence of the depressed bone being overlapped considerably by the remainder of the cranium. We are here obliged to remove a portion of the skull, to allow of the introduction of the point of the elevator beneath the depressed bone. No more should be removed than is absolutely necessary for the purpose. The trephine or Hey's saw may be used for the removal of the bone. If the trephine be used, a piece of bone corresponding to one half only of the crown of the instrument, or a little more than one half, so as to allow of the fixing of the pin, will be in general sufficient. These instruments, it is evident, should not press or act on the depressed portion of bone.

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* The symptoms of compression are not *always* proportionate to th extent of the depression: many cases are recorded in which the bon was depressed to the extent of an inch and more, without a singl bad symptom.

The bone being elevated, the symptoms of compression frequently disappear. This is not always the case, as some blood may be extravasated in the interior of the cranium, which still presses on the brain, or this organ may be so injured as to prevent it resuming its accustomed functions immediately. We have recourse again to the antiphlogistic regimen, which, if the extravasated blood be not large in quantity, or the injury of the brain not great, will succeed.

In few cases is the surgeon justified in having recourse *immediately* to the removal of a portion of the cranium, being those only in which the symptoms of compression are so violent as not to yield to bloodletting and threaten the immediate death of the patient; or where a portion of the bone is driven into the dura mater and brain, which latter case is in general indicated by spasmodic twitchings of the muscles of the face, or other part of the body, and most frequently on the side opposite that which has been injured.

Fractures of the skull, from the intimate connexion which exists between the bones of the cranium and the membranes of the brain, especially the dura mater, which forms an internal periosteum to the former, as well as an external covering to the latter, are frequently followed by meningitis.

Injuries affecting the brain. The brain is exposed to two kinds of injury from violence, namely, *compression* and *concussion*.

Compression, as its name implies, is caused by pressure on the brain, exercised by some agent or another. This may be a depressed bone, extravasated blood, or matter formed as the result of inflammation. The symptoms are the same, no matter what the cause may be; they are, general insensibility, dilated pupils, insensible retina, stertorous breathing, slow labouring pulse, confined or relaxed state of the bowels, retention of urine or stillicidium urinæ. These symptoms are liable to some variations; thus, one pupil only may be dilated, or both may be even contracted, the stertorous breathing may be wanting altogether, and the pulse is frequently irregular, as well as slow. A relaxation of the sphincters, admitting of an involuntary discharge of the fæces and urine, is a worse symptom than retention of these discharges. We have already described the treatment to be adopted in case of a *depressed bone* producing dangerous symptoms. We may mention, in addition, that the inner table of the skull is, in some cases, alone broken, and this pressing on the brain produces the most violent symptoms. The application of the trephine can alone enable us to raise the depressed portion of bone.

Extravasated blood may be produced from a rupture of some of the meningeal arteries, of one of the sinuses, or of the veins in the interior of the brain. The situation of the extravasation, therefore, depends on the vessel injured, and thus the blood may be effused, either between the bone and dura mater, into the arachnoid sac, on the surface of the brain, or in its substance. Unfortunately, there are no peculiar symptoms which indicate the precise situation, in which the blood is extravasated. When the compression appears to be caused by effused blood, we have recourse to general bloodletting, in order, first, to restrain the further effusion of blood, and to relieve the brain as much as possible from the compression, by diminishing the quantity of blood circulating in its veins; secondly, to increase the action of the absorbents, and prevent the occurrence of inflammation. Bloodletting should be followed by the free use of purgative medicines, of which calomel, succeeded by saline aperients, is to be preferred. When these medicines do not act on the bowels, a terebinthinate enema should be administered. If retention of urine be present, the fluid is to be drawn off with the catheter.

When these remedies fail to give relief, and the patient appears to be sinking beneath the effect of the compression, the trephine is our last resouce. By removing with this instrument a portion of bone over the stricken part we shall give vent to any fluid effused between the skull and dura mater; but when the fluid has been effused in the other situations mentioned, but little success will follow our operation. Puncturing the dura mater will have but little effect, as the blood, when in the arachnoid sac, gravitates towards the base of the cranium, or is spread over the surface of the brain, and having become coagulated, cannot be removed. If blood be effused still more deeply, it is beyond the reach of art. Having then trephined the patient without success, we can only hope for the absorption of the effused fluid. The action of the absorbents should then be stimulated by the application of blisters to the head and the exhibition of mercury. It too frequently happens that the patient sinks before the effused fluid can be absorbed, and even in the most favorable cases a certain degree of paralysis often remains for a long time after the injury. What adds to the difficulty of treating such cases is, that the blood is not always effused opposite the stricken part, indeed it may be at some far distant point, and then we are frequently misled in the application of the trephine. So little success has followed the use of the trephine in such cases, that some surgeons repudiate its use altogether; this is, we must say, an error, as cases will be occasionally benefited by its application.

Purulent matter may be found between the bone and dura mater, in the arachnoid sac, on the surface, or in the substance of the brain. This is always preceded by inflammation. When the matter is formed between the bone and dura mater, Pott's puffy tumour generally, but not always, indicates its existence. Here we may expect some success from the trephine; but when it has been effused into any other of the situations mentioned, we can entertain but little hope of the patient's recovery. The formation of matter is generally indicated by the subsidence of the acute inflammatory symptoms, and the appearance of convulsions of the side of the body opposite the seat of its formation. In some cases paralysis is present with convulsion; and in others a cataleptic state of the limbs exists. In a few cases, one side is paralysed whilst the other is convulsed.

Concussion of the brain is a violent commotion or shaking of this organ, by which a certain train of symptoms is induced. In most cases no manifest injury to the brain can be observed after death; in some, the organ is lacerated or torn in part. Concussion is caused by a violent blow or fall on the head. Mr. Abernethy has divided concussion into three stages: the *first* stage is that of "*collapse;*" the second is that of "*reaction;*" the third that of "*inflammation.*"

The stage of *collapse* immediately succeeds the injury; it is indicated by general insensibility, the patient's breathing is difficult, but in general without stertor; his pulse is rapid, intermitting, and with difficulty felt, and his extremities are cold. This stage generally lasts but a short time, as it is either followed by death or by the second stage.

Reaction. In this, the pulse and respiration improve, the surface of the body becomes warm, the patient becomes partially sensible to external impression, and winces or cries out if the skin be pinched, or he is otherwise irritated; he sometimes answers questions, if asked in a loud tone of voice, and particularly if it relate to the acciden or his present condition; otherwise he answers incoherently, and mutters rather than replies to any question the pulse is quick, the pupils generally contracted, th bowels confined, and the urine retained; or these secretions may be passed involuntarily, as in compression. Th stomach in this stage becomes irritable, and vomiting frequently ensues. The duration of this stage is extremel variable, it may last but a few hours, or may continue for weeks; it is generally followed, in the course of twenty-four or forty-eight hours, by the third stage.

Stage of inflammation. In this the patient becomes more restless, frequently muttering broken sentences; his countenance is flushed, his skin hot, his pulse quick and often hard, his bowels confined. If this stage be not moderated by appropriate treatment, matter forms, most frequently in the substance of the brain, and the patient dies convulsed.

The *treatment* of concussion varies according to the stage present. In the first, or that of collapse, diffusible stimulants, such as ammonia, ether, &c. should be administered to the patient, and warmth applied to the feet and surface of the body. Bleeding in this stage is highly injudicious, unless it should appear that there is some congestion about the head or thorax, which may be relieved by the cautious abstraction of a few ounces of blood. In the second stage, we guard against inflammation by the use of cold lotions and leeches to the head, purgatives to free the bowels, and the abstraction of blood from the arm. Bleeding should not be performed too soon, nor in too large quantities, as we may bring on the stage of collapse by the former practice, and by the latter prevent the reparation of the injury frequently done to the brain. In the third stage of concussion the strictest antiphlogistic regimen becomes necessary, followed, if the symptoms should continue, by the use of mercury, in order to prevent the disorganization of the brain.

Concussion may terminate fatally in any one of its stages: in that of collapse, from the violence of the injury; in that of reaction, from the same cause, or a congestion of the veins of the pia mater; in that of inflammation, from the effusion of matter. It frequently happens that although concussion has not proved fatal, it is followed by a lesion of the functions of the brain; in some, this is indicated by partial or complete loss of some one or more of the senses; in others, by squinting, loss of memory, and particularly that of languages; and in many, by a degree of fatuity, bordering on or extending to idiocy.

Many attempts have been made to distinguish between concussion and compression by the symptoms, but this, we may at once say, is in most cases impossible. Sir Astley Cooper states, as distinguishing marks, that in concussion, when the patient attempts to rise, his pulse becomes accelerated; the carotid arteries pulsate with great force; and the patient can, in general, be roused to some degree of consciousness. The history of the case may enable us to decide, where we cannot do so by the symptoms. Thus, if an individual receive a severe blow from a fall, which deprives him of consciousness for a short time only, and that, after recovering, he again becomes insensible, this is a case of concussion, followed by compression. The blow or fall produces insensibility, by the violence of concussion; a blood-vessel is ruptured at the same time, which pouring out blood at length produces compression, after an interval of consciousness. Should the ruptured blood-vessel be large, or the concussion last for a sufficient length of time, the patient may pass at once from a state of concussion into one of compression.

Fractures at the base of the cranium. The skull is sometimes fractured through its base, the fracture traversing generally the temporal and occipital bones into the foramen magnum. This accident is caused by falls on the top of the head from a great height, on some broad hard surface. The bones then do not give way at the part stricken, but, in consequence of the mechanism of the articulation, at the base of the skull. In addition to the usual symptoms of compression there is bleeding from the ears, nose, and, in some cases, from the eyes; there is also a serous discharge from the external meatus auditorius. These cases seldom recover, as, independently of the great injury done to the brain by the violence of the shock, there is in general a large quantity of blood extravasated about its base, proceeding from one of the sinuses, or from the carotid artery.

Operation of the trephine. The surgeon, having decided on the necessity of performing this operation, proceeds in the following manner. If there be no external wound, an incision is made through the scalp down to the bone. This may be a crucial, a straight, a T, or a V incision. The number of angles left in the crucial incision makes it objectionable. The bone being exposed and the periosteum removed to a sufficient extent, the pin of the trephine is fixed into the cranium and the instrument moved through a semicircular space, by the alternate pronation and supination of the hand, until the teeth have passed some distance into the bone. The pin of the trephine is now to be withdrawn, the teeth brushed so as to remove the dust of the bone, and the operation proceeded with as before, until the bone is nearly sawn through. As we cannot, *à priori*, ascertain the thickness of the bone, we proceed cautiously, feeling with a toothpick or other sharp-pointed instrument to what depth we have already gone, and what extent of the bone still remains to be sawn through. As soon as we have passed nearly through the bone,* we raise the piece with the elevator, taking care in so doing that the instrument does not slip and penetrate into the dura mater and brain. If one application of the instrument should not be sufficient it may be repeated, the projecting angles of the bone being afterwards removed with Hey's saw, and all irregularities of the cut surface destroyed.

There is no part of the cranium, except its base, where it is beyond our reach, that surgeons do not now operate upon, as no danger is found to arise from the hemorrhage from the sinuses or the meningeal arteries, a dossil of lint being found sufficient to restrain both one and the other. Mr. Abernethy states that, if the bone on being divided does not bleed it has perished.

The space left in the skull, by the removal of a portion of bone, is never completely closed; the cut edges of the bone throw out granulations, which afterwards become ossified, but always leave a small interval not ossified in or about the centre.

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* One part of the bone should be pressed on with the saw more than the rest, in order that by sawing our way through this we may be guided in sawing through the remainder.

Hernia cerebri. When a considerable portion of the skull has been lost, and especially if the dura mater have been destroyed, a protrusion of the substance of the brain takes place, forming a hernia cerebri. This affection is best treated by the application of pressure. It is most frequently fatal, from the loss of the cerebral substance, and consequent irritation which ensues.

Fungous tumours sometimes protrude from the cranium; these grow either from the dura mater or substance of the brain. It is recommended to remove them by ligature or the knife. Pressure has also been adopted. They usually terminate fatally. Fungous growth from the dura mater, or substance of the brain, should be carefully distinguished from a hernia or protrusion of the cerebral substance.

DISEASES OF THE EYELIDS.

The principal diseases of the lids are entropium and ectropium. They are also subject to the formation of tumours, to abscesses, tinea ciliaris, hordeolum, lagophthalmia, and ptosis.

Entropium (Trichiasis) is an inverted state of the eyelashes and tarsal cartilage, most frequently of the upper lid, whereby the former are forced against and irritate the conjunctiva, so as to induce chronic inflammation of it, and frequently destruction of vision. This disease is almost always preceded by inflammation of the conjunctiva, which, causing the disease at first, is subsequently aggravated by its continuance. It may be caused also by the presence of tumours in the lid, the cicatrices of ulcers, burns, &c. In the early stages, the hairs only are misplaced, but in the more advanced, the tarsal cartilage becomes curved, and adds to the patient's suffering. If seen at an early period, the disease may be removed by the use of leeches, moderately astringent lotions, and the extracting of the displaced eyelashes. When more advanced, it will be necessary to have recourse to an operation, to remedy the curved state of the cartilage. Scarpa recommends for the purpose the removal of a fold of the integuments of the lid, in the following manner:

> Pinch up a fold of the skin in the transverse direction with a forceps, or between the finger and thumb, and remove it with a probe-pointed sharp curved scissors, taking care that one blade of the scissors is placed near the edge of the cartilage, so that this may be acted upon more completely, in the cicatrization of the wound. The edges of the wound are to be brought together by suture and adhesive plaster. In a few days the wound heals, and by its contraction remedies the curve in the tarsal cartilage. The extent of the fold removed should be regulated by the degree of curve which the tarsal cartilage has undergone.

Mr. Saunders has recommended the cutting away the edge of the tarsal cartilage, thus removing the eyelashes altogether. This plan is objectionable, as it causes great deformity, and leaves the eye unprotected.

Mr. Crampton conceives this disease to be caused by a spasmodic action of the levator palpebræ superioris muscle, which draws in the edge of the tarsal cartilage. The following is his operation modified by Mr. Guthrie:

> With a small narrow knife, or blunt-pointed scissors, make a perpendicular incision through the eyelid, close to the external angle; this being done, make a second near to the internal angle, close to the outer side of the punctum lacrymale, remove a fold of the skin, as in Scarpa's operation. Evert the flap of the eyelid, pass a suture through each angle, and by these, retain it on the forehead with the aid of adhesive plaster. The wounds are to be carefully dressed on the second and third days, after which the flap may be restored and allowed to unite with the remainder of the lid. Instead of removing a fold of skin from the outer surface of the lid, Mr. Crampton recommends a transverse incision to be made through the tendon of the levator palpebræ superioris, on the inner surface of the lid: this plan is not generally practised.

Quadri recommends the application of the sulphuric acid to the skin of the upper lid, by means of a small piece of wood. The contraction produced by the acid causes the eversion of the edge of the lid, and thus removes the disease.

In the early stages, Scarpa's or Quadri's operation may be performed, but in the more advanced, Mr. Crampton's will be found more effectual. Some writers assert that the disease named trichiasis is caused by the presence of an unusual row of eyelashes; this if not altogether imaginary, is exceedingly rare.

Ectropium is a turning out or eversion of the eyelids, generally the lower. This disease is caused by the contraction of cicatrices in the neighbourhood of the lid, or by a fungous state of the conjunctiva. In the first case the cicatrix should be carefully detached, and the everted lid replaced; the wound being made to unite by granulation, so as to prevent the lid being again everted by the action of cicatrization. This, however, is an exceedingly difficult task, particularly when the cicatrix has been the result of a burn.

Sir W. Adams recommends the removal of an angular portion of the lid, resembling the letter V, the base corresponding to the free edge of the cartilage. After its removal, the edges of the wound are brought together by suture. This plan is useful when the eversion has been of long continuance.

When the disease of ectropium is caused by a fungous state of the conjunctiva, this should be removed by the use of astringent lotions. Should these be found ineffectual, the fungus may be removed with the knife, scissors, or by the application of caustic.

Ectropium proves destructive to vision by leaving the eye exposed to foreign bodies, dust, &c. whereby a chronic inflammation of the conjunctiva is induced, which terminates in rendering it thickened and opaque, thus causing a nebulous state of the cornea.

Tumours form most frequently in the upper lid. They are removed by making a transverse incision through the integuments down to the cyst, and then dissecting or turning it out with the scalpel. No portion of the cyst should be allowed to remain. They may be also removed from the conjunctival surface of the eye by similar means. If not removed in time they will destroy vision by compressing the globe of the eye, and inducing a chronic inflammation of the conjunctiva. Their removal is not unfrequently followed by erysipelas.

Abscesses in the Lids should be opened in the transverse direction, in order that the cicatrix may be concealed by the folds of the integuments. *Ecchymosis* of the lid is an effusion of blood into its cellular tissue. The absorption of the effused fluid should be expedited by the use of cold evaporating lotions.

Tinea ciliaris. This is an inflamed and partially ulcerated state of the edges of the lids, which occurs in scrofulous patients, and is attended with more or less inflammation of the eye itself, accompanied by a diseased secretion of the meibomian glands. The diluted Ung. Hyd. Nitratis, or Ung. Hyd. Nitr. Oxydi, should be applied to the edges of the lid at bedtime, and the eye occasionally bathed with a weak solution of sulphate of zinc.

Hordeolum or *Stye* is a furuncular inflammation of one of the meibomian glands. A small reddish and painful tumour forms on the edge of the lid, this soon breaks, and a little matter is discharged, with, perhaps, a slough of the cellular membrane: the disease then subsides.

Lagophthalmia is a permanently open state of the lids. It is a disease rarely met with.

Ptosis is a drooping of the upper lid, caused by a paralysed state of the levator palpebræ superioris. It is a frequent forerunner of apoplexy, but may be caused by pressure on or injury of the third nerve, independently of any affection of the brain.

DISEASES OF THE EYE

Are best considered with reference to the structures which enter into the formation of this organ.

Diseases of the Conjunctiva:

Conjunctivitis (Ophthalmia). The conjunctiva is subject to the acute and chronic inflammation, purulent or gonorrhœal, and scrofulous or strumous inflammation.

Acute Conjunctivitis is produced by foreign bodies entering the eye, such as particles of dust, lime, &c. It may be also caused by exposure to cold, a blast of cold air directed on the eye, by a too great degree of light, or by wounds or blows on the eye. The patient at first complains of a feeling of sand in the eye; this is caused by the irregular distension of the vessels of the conjunctiva.

This symptom is soon succeeded by increased vascularity of the membranes, pain in the globe of the eye, extending to the forehead and back of the head, increased heat, a diminished secretion, and intolerance of light. If the inflammation be severe, the constitution participates, and general fever is the result. In this stage, leeches should be applied, immediately below the eye, the bowels opened by active purgative medicines, and, if necessary, blood should be taken to the extent of twelve or fourteen ounces from the arm or temporal artery.

As the disease advances, all the symptoms become aggravated, the secretion from the eye becomes increased in quantity, and assumes a muco-purulent or purulent character, which causes the agglutination of the lid, and, flowing from the eye, excoriates the integuments of the cheeks. If this state of things be not removed by appropriate treatment, the inflammation spreads rapidly to the deeper-seated structures of the eye, and disorganization takes place, causing a complete or partial loss of vision. If properly treated, the inflammation of the conjunctiva gradually subsides, and the patient recovers the use of the organ. Generally speaking some weakness of the eye remains for a considerable time. When the inflammation has been violent, *chemosis* makes its appearance. This occurs in a few days after the commencement of the disease, and is caused by an effusion of serum from the vessels of the conjunctiva into the cellular tissue, which connects the membrane with the sclerotic coat. In this, the conjunctiva is raised from the sclerotic coat by the effusion beneath it, which, terminating abruptly, at the edge of the cornea, gives to the latter a sunken appearance. Although the patient feels in general relieved by the effusion, active antiphlogistic remedies are still necessary. Blisters will now be found useful, particularly if applied at some distance from the disease, that is, behind the ear, at the back of the neck, or on the temple.

Acute conjunctivitis may terminate as follows, causing either a partial or complete loss of vision; by

1. *The formation of pustules on the cornea.* One or

many pustules may form on the cornea; in the latter case, the inflammation is generally of a scrofulous character. They are caused by an effusion beneath the conjunctiva covering the cornea, which raises the membrane so as to form a small conical or semi-globular projection. This, from its transparency and short continuance, is frequently not discovered. The pustule soon breaks and an *ulcer* is formed on the cornea. This is of a conical shape, the apex towards the interior of the eye, and is in general transparent. When small, it is best seen by placing the eye in different lights, and examining the eye attentively; when large, it is at once obvious. These ulcers are said not to secrete pus, nor to form granulations. They are attended with considerable pain and cause much irritation to the patient.

Ulcers of the cornea should be touched freely with the solid nitrate of silver, or with a strong solution of the substance, in the proportion of 10 or 20 gr. to the ounce of distilled water. If disposed to heal, lymph is effused from the surface of the ulcer, the cavity of which is thus filled up. In general, some degree of opacity remains from this process, which may be removed by the use of astringent lotions, such as the Lotio Sulph. Zinci, gr. iij. with ℥j. of water, or by the solution of nitrate of silver, or the Tinct. Op. Vin. dropped into the eye. When an ulcer or ulcers form in the centre of the cornea, they interfere much with vision; as they usually form, however, near its circumference, the sight is not much impaired by them.

Ulcers of the cornea, if neglected, gradually sink deeper through this structure, and finally open into the anterior chamber of the eye. The aqueous humour now escapes, and, bringing with it the floating edge of the iris, this membrane protrudes through the ulcer, so as to form a slight blackish projection over the surface of the cornea, forming a *hernia* or *staphyloma* of the *iris*. This is usually attended with great pain and an increase of the inflammation. The extract of belladonna should now be applied round the eye, so as to cause the retraction of the protruded iris, if possible, and the ulcer touched with the nitrate of silver. This can be seldom accomplished, as the iris rapidly contracts adhesion to the margins of the ulcer, a circumstance indicated by the irregularity in the shape of the pupil. Here, the application of the nitrate of silver to the protruded iris is beneficial, as it at once destroys the sensibility of the protruded part and relieves the patient. The ulcer now frequently heals, and the patient recovers vision, without suffering any inconvenience from the irregularity of the pupil. Where a number of ulcers form on the cornea, vision may be wholly destroyed by the opacity that results from the healing process, and which is never afterwards removed. The same result may follow from a single ulcer, and particularly where the iris has been protruded.

2. *Thickening of the conjunctiva covering the cornea.* This is more frequently the result of chronic than of acute conjunctivitis. In this, red vessels pass along the thickened conjunctiva over the cornea, and, inosculating, form an opaque vascular membrane, destroying the transparency of the cornea.

The division of the vessels at a short distance from the edge of the cornea, or, what is preferable, a removal of a portion of them, followed by the application of blisters in the neighbourhood of the disease, and the use of astringent lotions, or solutions of the nitrate of silver, will sometimes succeed in restoring vision.

3. *Effusion of lymph between the layers of the cornea—leucoma, albugo.* This is caused by an extension of the inflammation to the substance of the cornea. The effusions present the appearance of white opaque spots, their effect on vision depends on their extent and their relation to the centre of the eyes. This appearance is named *leucoma* or *albugo*. Some authors confine the term albugo to the effusion of lymph on the surface of the cornea. The *treatment* of this affection consists in stimulating the absorbents to the removal of the effused lymph.

4. *Extension of the inflammation to the interior of the eye.* This is characterized by an increase in the inflammatory symptoms. The patient complains of a sense

of tension or constriction of the eyeball; the pain becomes obtuse, deep, and throbbing, and quickly propagates itself over the eyebrows to the top of the head; the pupil loses its clear, shining blackness, and becomes contracted; vision is imperfect or wholly lost, the iris changes its colour from gray or blue to green, and from brown or black to a reddish hue, and presents a swollen appearance; the vessels of the sclerotic coat become turgid with blood, so that the external surface of the eye is covered with vessels of a bright red colour, and the cornea loses its natural brilliant colour, presenting a hazy or partially opaque appearance. At the same time the constitutional symptoms become aggravated, violent fever sets in, and the patient suffers under acute headach, which prevents him taking rest.

If these symptoms be not relieved, matter forms in the anterior chamber. This is at first small in quantity, but soon increases, so as to occupy a great portion of the anterior chamber. The matter, gravitating to the lower part of the anterior chamber, assumes a semicircular shape, forming the case termed *hypopion*. If the disease be left to itself, the matter collects in such quantity that the cornea is rendered more prominent, assumes a conical shape, and ultimately bursts during an aggravated attack of pain; when the matter is discharged the eye shrinks, and the sufferings of the patient gradually cease, vision being destroyed. The matter in hypopion may be formed directly from the surface of the membrane of the aqueous humour, but more frequently an abscess forms in the interior of the eye, and in general on the anterior surface of the iris, which, bursting, gives rise to the appearance described. When the inflammatory symptoms are thus severe, lymph also is in general effused into the interior of the eye, which either closes the pupil or causes the adhesion of the iris to the lens behind, or the inner surface of the cornea in front; thus impairing if not destroying vision.

To prevent the destruction of the eye, the most acute antiphlogistic regimen should be adopted and mercury exhibited to salivation; thus, even when matter has been formed, we succeed in preserving vision by causing absorption of the pus. The extract of belladonna should also be used freely around the eye to prevent the adhesions of the iris, or to break through them when formed. When violent inflammation extends to the interior of the eye, vision may be destroyed without the formation of matter, by causing a disorganization of the retina and humours of the eye. The practice of opening the cornea, in cases of hypopion, should not be resorted to unless the symptoms are very urgent and the eye is so distended with matter, that the cornea is in the state of an abscess and threatens to burst. The formation of matter in the interior of the eye is usually preceded by shiverings.

Chronic conjunctivitis may succeed acute conjunctivitis, or commence as an idiopathic affection. It is characterized by a pale redness of the vessels of the conjunctiva, slight pain in the eye, an increased secretion of tears and imperfect vision. In the advanced stages, the conjunctiva lining the lids present a granulated surface; this, by rubbing over the eye, irritates the organ, increases the inflammation, and ultimately induces thickening of the conjunctiva covering the cornea, thus destroying vision. Chronic conjunctivitis is treated by the application of blisters to the temples, behind the ears, and on the back of the neck; the occasional use of leeches below the affected eye, or to the cutaneous surface of the lower lid. If granulations be present, they should be removed by the free application of the sulphate of copper in substance. The nitrate of silver solution, gr. x to ℥j, dropped into the eye, will also be useful, as also the application of the dilute nitrate of mercury ointment applied to the margins of the lids.

The *general treatment* of inflammatory affection of the eyes is regulated by the principles applicable to inflammation in other parts. Thus, when acute inflammation is present, bleeding, leeches, purgative medicines, and antimonials will be found useful, followed, if necessary, by the exhibition of mercury. In the less acute forms, the nitrate of silver solution, varying in strength according to the degree of inflammation, the Lotio Sulph. Zinci, Lotio Acet. Plumbi, the Ung. Oxyd. Zinci, Nit. Hyd. dilut. will be found beneficial. Some recommend the scarification of the conjunctiva covering the lids as a substitute for leeches; but this is frequently followed by an increase of the irritation. Warm fomentations and cataplasms to the eye are also of service. The extract of belladonna applied round the eye is useful in preventing adhesion of the iris taking place; some object to its use in the early stages of the inflammation, on purely theoretical grounds. A green shade relieves the patient, by excluding the light and irregular currents of air.

Scrofulous or *strumous* conjunctivitis occurs generally in children; it is characterized by pale redness of the vessels of the conjunctiva, excessive intolerance of light, a profuse secretion of tears, and by the presence of scrofula in other parts of the body. The treatment is more constitutional than local. The taint in the constitution should be removed by attention to the stomach and bowels, the use of iodine in the form of iodide of potassium, and iodide of iron; the assistance of proper food, moderate exercise, and good air. As local remedies, leeches, blisters behind the ears, the solution of nitrate of silver, the vinous tincture of opium, the oxyde of zinc, or dilute nitrate of mercury ointments are found beneficial. A seton in the neck, or issues in the temple or arm, often remove the disease when other remedies have failed. This inflammation generally destroys vision, by the formation of ulcers on the cornea.

Purulent or *gonorrheal Ophthalmia.* It is disputed whether this disease is induced by the direct application of gonorrheal matter to the eye, or by a metastasis of the gonorrheal inflammation from the urethra. It is characterized by great swelling of the conjunctiva, which is frequently protruded beyond the lids, followed by a discharge of greenish yellow matter, in large quantities. The heat and pain in the eyes are considerable, an aversion to light prevails, and in some instances an appearance of hypopion is visible in the anterior chamber of the eye. Purulent inflammation of the conjunctiva destroys vision by inducing opacity of the cornea, by inflammation extending to the interior of the eye, or by causing a sloughing of the cornea. In the latter case, successive layers of the cornea are thrown off, which, previous to their separation, lose their transparency, and present an irregular appearance, not unlike a false membrane, partially detached from the part. The cornea being thus destroyed, the eye bursts, the humours escape, and vision is lost. The eye is sometimes lost in this disease in the course of twenty-four hours. Purulent ophthalmia is treated in the inflammatory stage by the local and general abstraction of blood, the use of purgative medicines, and alterative doses of mercury. When the violence of the inflammation has been partially subdued, the solution of the nitrate of silver gr. xx. ad ℥j., applied freely to the inflamed surface is beneficial. Should the symptoms not yield to this treatment, mercury becomes necessary. The ordinary antiphlogistic regimen is not so effectual in this as in most other imflammations.

Purulent ophthalmia of *infants.* Children are also subject to a purulent inflammation of the conjunctiva. It usually appears a few days after birth, seldom at birth, and is considered to be caused by the acrid or diseased discharges from the mother coming in contact with the eyes of the child. The symptoms are similar to those of the adult. The treatment is also similar, excepting that the same active remedies cannot be applied, in consequence of the age of the patient. The astringent solutions of sulphate of zinc or copper should also be injected into the eye frequently during the day. Mr. Guthrie recommends his nitrate of silver ointment to be applied to the inner surface of the eyelids. Many prefer the careful application of solid nitrate of silver to the inflamed conjunctiva.

Egyptian Ophthalmia is another form of purulent ophthalmia; it does not differ materially from the simple purulent ophthalmia already described.

Encanthis is a chronic growth from the caruncula lacrymalis, and neighbouring fold of the conjunctiva, which extends outwards, and is usually prolonged over the margins of the lids, in the form of small tail-like processes, compared to the swallow's tail. It causes much irritation and finally inflammation of the conjunctiva. The diseased growth should be carefully removed with the scissors or sharp knife.

Pterygium is a thickening of the conjunctiva, of a triangular shape, proceeding with the apex towards the cornea, and commences usually from the caruncula lacrymalis. When thin, it is named *membranous;* but when thick and well marked, *fleshy.* The membrane should be dissected off the surface of the eye, to prevent its being prolonged over the cornea, thus destroying vision.

The *Cornea* is never the seat of primary idiopathic inflammation; its diseases are induced by inflammation, and proceeding most frequently from the conjunctiva.—Vide ulcers of the cornea, nebula, leucoma, &c.

Staphyloma. In this disease the cornea projects forwards, so as to form a conical or irregularly-shaped tumour, which prevents the approximation of the lids, and gives rise to inflammation of the eye. The cornea being opaque, and the iris adherent to its posterior surface, we can only relieve the patient from the irritation caused by the projecting tumour, without restoring vision. This is done by making an incision into the cornea, and allowing the confined humour to escape, when the eye collapses. We are informed that Dr. Jacob, of Dublin, practises the passing of a seton across the anterior chamber with much success.

Iritis (Inflammation of the iris) may be either *idiopathic* or *specific. Idiopathic* iritis is characterized by more or less vascularity of the sclerotic coat, the vessels of which present a light red colour, and take a straight course towards the margin of the cornea, within about one line of which they unite and form a vascular zone around it; the iris changes in colour from a blue or gray to a green, and from black or brown to red; the change commencing near its free margin; the membrane also becomes swollen, its pupillary margin being indistinct, or less sharp than natural, and is thrown forwards towards the cornea; the pupil becomes contracted, and vision is seriously impaired. The aqueous humour also frequently presents a muddy appearance. These symptoms are attended with an obtuse, heavy, deep pain in the eye, extending towards the back of the head; intolerance of light, and constitutional disturbance. Idiopathic iritis is best *treated* by the strict observance of the antiphlogistic regimen, followed by mercury to salivation. Belladonna should be applied freely, so as to prevent any adhesion of the iris to the capsule of the lens. Iritis may destroy or injure vision, by causing adhesion of the iris to the capsule of the lens or cornea; by the effusion of lymph, closing the pupil; or by the formation of matter in the anterior chamber of the eye (hypopion). This last termination is of frequent occurrence. A few days after the commencement of the disease, if the inflammation be not arrested, one or more *tufts* of lymph, of a whitish yellow colour, appear on the anterior surface of the iris, advance to suppuration, and an abscess is thus formed. This soon bursts, and the matter is discharged into the anterior chamber.

Specific Iritis is that form of iritis which appears in company with some specific disease of the constitution, such as syphilis, chronic rheumatism, and gout. Of these, *syphilitic* iritis is the most frequent; it appears as one of the earliest of the secondary symptoms of syphilis, generally in company with the papular eruption, pains in the bones, and sore throat, but may be found along with any other eruption. The principal points of difference between this and the idiopathic iritis are as follows: the pain in syphilitic iritis is usually not so great as in the idiopathic form; it is also liable to exacerbation, being most severe at night; the aqueous humour is more turbid, and the pupil is drawn upwards and inwards. The tufts of the lymph which appear on the iris are more of a reddish or orange colour, and form more rapidly. The treatment is the same as in idiopathic iritis. Iritis sometimes appears after the immoderate use of mercury, or in debilitated constitutions: here the exhibition of Sp. Terebinthinæ in half drachm doses is found useful. The turpentine is best given in almond emulsion. Iritis appears occasionally after fever; here the sulph. of quinine should be exhibited.

Rheumatic inflammation of the eye generally attacks first the sclerotic coat, from which it spreads to the other structures of the eye. It is characterized by the vessels of the sclerotic presenting a brick-red tinge, or an admixture of yellow with crimson red, irregular vascularity of the sclerotic (Mr. Wardrop denies this), rheumatic pain in other parts of the body, as also in the brow, cheek-bone, teeth, and lower jaw, or in the side of the head, remission of the pain, which is most severe towards midnight. The remedies adapted to this form of ophthalmia are constitutional, rather than local, and are those in use for the treatment of rheumatism in general. Should the inflammation attack the deeper seated parts of the eye, mercury becomes necessary.

ON CATARACT.

Cataract is an opaque state of the *lens*, or its *capsule*, or both, whereby the rays of light are prevented from entering the bottom of the eye. Cataract may be caused by injury or by inflammation, extending from other parts of the eye, but more commonly appears as an idiopathic affection. It is more frequently met with in advanced life than in young persons; there is, however, a form of the disease which exists even at birth, hence named congenital cataract. The first symptoms of the disease are usually a number of dark specks, *muscæ volitantes*, floating in view, and a generally impaired state of vision. As the disease advances, vision becomes more imperfect, until at length the patient can see only in dim light, when the pupil becoming dilated, the rays of light pass beyond the opaque portion of the lens, the opacity commencing in general in its centre. On examining the eye, the opaque lens appears behind the pupil, and thus points out the disease. Lenticular cataract is divided into the *hard*, *soft*, and *fluid*.

Hard cataract is usually small, and of a brown or amber colour, and occurs in advanced life. Vision, from the size of the cataract, is more perfect than in the other forms.

Soft cataract is of the consistence of cheese; it is large, regularly opaque, and of a whitish colour.

Fluid cataract is of a milky white colour; is large, and intermixed with dark specks, which change their place in the fluid, according to the motions of the patient. Vision is very imperfect.

In the last two forms, from the size of the cataract, which obliterates the posterior chamber, the iris is protruded forwards, and its motions interfered with.

Capsular or *membranous* cataract. This form can be only distinguished as a distinct disease when the posterior part of the capsule of the lens alone is affected. The opaque substance appears then at a distance from the pupil, and of a concave shape.

The *congenital* cataract is of the membranous form, the lens having been absorbed.

There is but one form of treatment for cataract, namely, operation. Before deciding on having recourse to an operation, the eye should be carefully examined, the extract of belladonna having been previously applied, so as to enable the surgeon to have a better view of the interior of the eye. If the sclerotic coat be firm and resisting, and not too vascular, if the cornea be not opaque, or otherwise diseased, the iris not adherent nor tremulous, the pupil free, and the patient capable of distinguishing light from darkness, the operation will be judicious; but if, on the contrary, the reverse of these symptoms be present, showing a disorganization of the eye, it should not be performed.

The principal operations for the removal of cataract are those of *depression*, *breaking up the lens*, and *extraction*. The operation of *depression*, or *couching*, consists in depressing the opaque lens from the axis of vision, into the bottom of the posterior chamber, or into the vitreous humour.

The patient having been placed in a proper position, the upper lid should be raised with the speculum, which may also press on, so as to fix, the eye, or this instrument may be dispensed with altogether.

The operator passes the needle from the outer side through the sclerotic coat into the interior of the eye, about one line and a half behind its junction with the cornea, and below the centre of the eye, to avoid the long ciliary artery. The point of the needle is first directed backwards and inwards, but is turned directly inwards as soon as it has passed into the posterior chamber; the point now appears behind the pupil. The operator now places the extremity of the instrument on the anterior and upper part of the lens, and thus depresses it. The needle is now withdrawn, and some lint, moistened with cold water, applied over the eye. The after treatment consists in guarding against any inflammation that may appear. When the lens is turned into the vitreous humour, so that its upper edge is directed backwards, its lower forwards, the operation is called *reclination* of the cataract.

Breaking up of the lens. This operation is performed as the preceding: the capsule of the lens having been cut through, the opaque lens is brought forwards into the anterior chamber, and then broken into fragments. The principle of cure in both cases is the same, the opaque lens being removed by the action of the absorbents. Some perform these operations by introducing the needle through the cornea; this is called the *anterior*, to distinguish it from the preceding, which is named the *posterior* operation. Hey's, Scarpa's, and Beer's needles for these operations, have each their advocates.

Extraction of the cataract consists in cutting through the cornea, so as to open into the anterior chamber, and then remove the lens. The cornea knife (and Beer's is that generally preferred) is first made to penetrate the cornea about one line *in front* of its junction with the sclerotic, and a little above its centre, by directing the point backwards and inwards; the cornea being perforated, the blade of the knife is pushed inwards, across the anterior chamber, in front of and parallel to the iris, and brought out on the inner side, exactly opposite the point of introduction of the knife, this being carried downwards, a flap is made of the lower half of the cornea. The lids are now to be closed, and the eye kept quiet for a short time; the flap is then raised, and the curved needle introduced into the anterior chamber, and the capsule cut through, when the lens will either fall out, or may be removed with the curvette. Some prefer making the section of the cornea upwards or obliquely to one side.

The operation of extraction is best suited to the removal of the hard cataract; those previously described to the soft species of cataract. In the performance of these operations, much care is required, in order to avoid wounding the iris, and in that of extraction, to prevent the escape of the vitreous humour. Children, affected with congenital cataract, should be operated upon before the age of four years. The operation best suited to this form of the disease is that of lacerating the capsule of the lens, either through the cornea, or by introducing the needle behind the edge of the cornea, as in the operation of couching.

ON AMAUROSIS.

Amaurosis is a paralysed state of the retina, or optic nerve, whereby vision is either very imperfect, or is wholly lost. The symptoms are impairment of vision, a dilated pupil, immoveable iris, and a bright metallic appearance of the interior of the eye. The disease is usually preceded by the appearance of muscæ volitantes, or flashes of fire before the eye, and not unfrequently by pains in the eye, orbit, or head. Amaurosis may depend either on a functional, or an organic disease of the retina, or optic nerve. In the former case, the abstraction of blood will be found useful, combined with counter-irritants, near the seat of the disease, and the exhibition of alterative doses of mercury. In the latter, we should use in addition tonic medicines, stimulant applications to the eye, and mercury in larger quantities, so as to produce salivation. Amaurosis is frequently caused by disease of the origins of the optic nerves, or brain itself. In these cases but little can be done for the patient.

GLAUCOMA.

This is a diseased state of the vitreous humour, which appears behind the pupil, of a greenish colour. The eye is generally disorganized, and is seldom recovered.

HYDROPHTHALMIA.

Is a dropsical state of the eye: the eye is distended with fluid, the sclerotic coat becomes thinned and the cornea widened, and vision is wholly lost. Treatment is generally of no avail. Puncturing the cornea, so as to draw off the effused fluid, has been tried, but with little success.

OPERATION FOR ARTIFICIAL PUPIL.

Where the natural opening in the iris has become closed, from previous inflammation or any other cause, it is proposed to form an artificial opening in the membrane. This is accomplished,

1st, by simply incising the iris, (*Corotomia*); 2d, by cutting out a portion of the iris, (*Corectomia*); 3d, by detaching a portion of the iris from the ciliary ligament, (*Coredialysis*).

The operation of corotomia is seldom resorted to. Corectomia is performed, as recommended by Mr. Gibson, by making an incision through the cornea into the anterior chamber, the iris being made to protrude, a portion of it is snipped off with the scissors. Coredialysis is performed by detaching, with the needle, the iris from the ciliary ligament, opposite a transparent part of the cornea. These operations in general fail, from the severe inflammation which supervenes.

EXTIRPATION OF THE EYE.

The globe of the eye is occasionally removed when affected with cancer or fungus hæmatodes.

The eye should be first fixed with a tenaculum, or suture, passed through its anterior part; with a straight double-edged knife the cellular tissue and muscles surrounding the eye are divided, the optic nerve is now cut across with a curved knife or scissors, and the diseased mass removed. The bleeding may be restrained by filling the orbit with dossils of lint. The lacrymal gland should be always removed with the eye, as it can be no longer of use when that has been extirpated, and it may cause a return of the disease if left.

The lacrymal gland may be removed, when desired, without injury to the globe of the eye. The operation is performed by making an incision through the upper lid, a little below the superior edge of the orbit, and then dissecting out the diseased mass.

For Cancer and Fungus Hæmatodes of the Eye, vide Cancer and Fungus Hæmatodes.

ON FISTULA LACRYMALIS.

Fistula lacrymalis is a disease of the lacrymal sac, caused by an obstruction to the flow of tears along the nasal duct. The symptoms of this disease are an epiphora, or watering of the eye, from the tears flowing over the inferior lid, a chronic inflammation of the conjunctiva of the eye, a distension of the lacrymal sac, attended with a discharge of a muco-purulent fluid mixed with tears from the puncta lacrymalia, when the sac is compressed, and a dry state of the corresponding nostril. Fistula lacrymalis may be produced by common inflammation, but it is frequently induced by a syphilitic taint in the constitution. It is divided into three stages, 1st, when there is only a simply distended state of the lacrymal sac; 2d, when there is inflammation and suppuration of the sac; 3d, where a fistulous opening has been formed in the lacrymal sac, by the escape of the purulent matter from the interior. In the first stage the disease may be relieved or removed altogether, by the use of leeches and fomentations to the eye, with the use of astringent ointments, to the edges of the lid, and the occasional injection of fluids, by means of Anelli's syringe, along the puncta lacrymalia, into the nose, or by the introduction of a fine probe or bristle.

In the more advanced stages an operation becomes necessary for its removal, this is performed as follows:

Make an incision with a sharp-pointed knife into the lacrymal sac, commencing it immediately below the tendo-oculi, and extending it downwards and outwards to the extent of about three quarters of an inch, parallel to, and to the outer side of, the angular vein and artery; pass a probe downwards into the nasal duct, to free the canal, then introduce the style and allow it to remain until the canal becomes permanently free, withdrawing it occasionally for the purpose o cleansing it. The wound should be dressed with a dossil of dry lint covered with a small piece of adhesive plaster.

Before deciding on the existence of an obstruction in the nasal duct, the state of the puncta lacrymalia an nasal cavity should be ascertained, as an obstructed stat of the former, or a tumour in the latter, will present mos of the symptoms of fistula lacrymalis. When fistula lacrymalis has been of long continuance, the os unguis becomes carious, and must exfoliate before the disease is removed.

Salivary fistula. This is a fistulous aperture in one of the salivary ducts, opening externally, through which the saliva escapes, and is generally caused by a wound. The duct of the parotid gland, from its exposed situation, is most liable to it. The patient suffers from the deformity caused by the disease, and from the injury to digestion, the consequence of the loss of the saliva. Where the wound of the duct is recent the edges should be brought together and united, if possible, by the first intention; the continuity of the duct is thus often preserved, or the external part of the wound uniting, the saliva flows directly into the mouth. Where a fistula has formed, a seton should be passed. Desault performed this operation in the following manner:

He introduced two fingers of his left hand into the patient's mouth and placing them between the teeth and the cheek, opposite the fistula, thus kept the integuments tense, and the gums from being injured. He then introduced a small hydrocele trocar with its canula, just before the opening of the posterior part of the duct, and pushed it through the cheek, in a direction a little inclined forwards. The trocar being withdrawn, a thread, with the seton attached, was drawn from the mouth, through the canula, which was then removed; the thread being allowed to remain out of the external wound, and fixed by adhesive plaster, so as to secure the seton in its inner part. In the course of a few weeks, the external wound being nearly closed, the seton was withdrawn, and thus a free canal was formed for the discharge of the saliva into the mouth.

DISEASES OF THE NOSE AND NASAL CAVITY.

Lipoma of the nose. This is a chronic enlargement of the integuments of the nose, and subjacent cellular substance, which frequently attains a large size. The tumours should be cut away in such a manner as not to injure the cartilages of the nose.

The principal diseases to which the nasal cavity is subject are polypous and other tumuors, and epistaxis.

Polypi of the nose appear in general in adult or advanced life. They have been divided by Mr. Pott into the benign and malignant. Mr. Bell considers that all polypi will, in the course of time, become malignant. Sir A. Cooper has divided them into the gelatinous, hydatid, fungoid, and carcinomatous, of which the first two may be considered as benign, the last two as malignant. Of these the gelatinous is the most frequent.

The *gelatinous* polypi almost invariably grow from the outer wall of the nasal cavity, from one of the spongy bones, most frequently the middle. The tumour may exist for some time before the patient becomes aware of its presence. As it increases in size, the passage of air through that side of the nose in which the tumour is situated becomes impeded, particularly during moist weather, when the tumour swells from absorption of the moisture and diminished pressure; the patient feels it moving during respiration, the sense of smell is impaired on that side, as is also that of hearing, from the pressure on the Eustachian tube; there is also a discharge of tears, or epiphora, from the corresponding eye, from the extremity of the nasal duct being pressed on, while that side of the nose is drier than usual, and the patient's voice becomes nasal. There is no pain attending the disease, and no external deformity, until the tumour increases in size, when it causes a projection on one side of the nose, and may appear through the anterior nares. On examining the nasal cavity, the polypus will be found of a palish or grayish light-brown colour, not unlike a grape, of a pyriform shape, being attached by its smaller extremity, slightly transparent, and possessing a few veins, which ramify near its root.

Removal is the only effectual treatment of polypi. They may be removed by extraction, the ligature, excision, or by the application of caustic.

Extraction is effected by means of a polypus forceps. A probe is first passed up the nose, to ascertain the precise situation and extent of the attachment of the polypus. The forceps is now introduced, and the tumour laid hold of by the root, for, if caught near the fundus it will break down and come away only in parts. The root of the tumour being firmly grasped in the blades of the forceps, the tumour may be removed by a sudden jerk, or by twisting the forceps round and then dragging it away. By this forcible removal of the tumour, its root sloughs, and the disease is completely eradicated. The removal of a portion of the spongy bone renders this still more secure. The polypus being removed, an examination of the nose should be made, to ascertain if any others exist. Should this be the case, they should be removed in like manner. The point of attachment of each polypus may be touched with the solid nitrate of silver, or a solution of this substance injected into the nose.

The ligature is seldom used, except where the polypus is attached far back in the nose, and projects into the pharynx posteriorly. In this case the tumour cannot be seen, but may be felt by passing the fingers through the mouth behind the velum. Deglutition is interfered with in such cases. The operation is performed as follows:

Through the double canula, pass a silver wire, so as to form a noose at one end, the two ends hanging out at the other end of the instrument. Introduce this into the nose, and, if necessary, into the pharynx. The noose is now to be passed round the neck of the polypus, by means of the fingers introduced into the mouth, and the silver wire drawn tight. Its ends are now to be secured to the ears of the canula, and this twisted until the tumour is sufficiently constricted, that is, until the circulation is completely arrested in it. The instrument is to be allowed to remain until the polypus drops away, which will take place in a few days. During the interval the wire should be tightened daily, by the twisting of the canula. It is safer to remove the polypus with the forceps as soon as it appears to be sufficiently detached than to allow it to drop away, as it may cause much distress by falling into the lower part of the pharynx.

Excision is performed with a blunt-pointed scissors or a probe-pointed bistoury; it should never be practised, as the subsequent hemorrhage is frequently alarming, and the root of the disease is still left. Caustic is objectionable from the difficulty of applying it in the proper place, and from its liability to spread. Children and young persons are subject to a relaxed state of the schneiderian membrane of the nose, which should not be mistaken for a polypus. The application of the nitrate of silver solution will in general be sufficient for its removal.

Hydatid polypi are generally met with in young people. They are easily ruptured, and when broken pour out a quantity of watery fluid. They are best treated by the chloride of antimony or some other escharotic.

Fungoid polypi are vascular, and cannot be removed from the hemorrhage which ensues on the attempt being made. They extend so as to occupy the whole of the nasal cavity. Sir A. Cooper recommends the use of the chloride of antimony. May not these tumours be aneurisms by anastomosis ?

Carcinomatous polypi appear in advanced life, and grow from the septum and roof of the nose. When examined they present an irregular surface, are of a deep red or purple colour, and are found to be attached by an extensive basis or root. They are attended with shooting, lancinating pains, which extend to the root of the nose and forehead, are not affected by the weather, and discharge a thin ichorous matter, and frequently blood. The granulations on the surface are hard, and bleed from slight injury. The constitution indicates a cancerous diathesis, presenting that leaden colour of the skin, so remarkable in this disease. Palliative means only can be resorted to, as any attempt at extirpation would only increase the affection, and induce, perhaps, a fatal hemorrhage. Opium and other narcotics will be found useful, as also astringent or anodyne solutions injected into the nose.

Carcinomatous polypi prove fatal, either from the constitutional disturbance they cause, or from spreading to the brain, producing inflammation or pressure upon that organ.

Epistaxis is a profuse discharge of blood from the nose. It may be either active or passive; the former occurring in early life, and preceded and accompanied by symptoms of plethora; the latter in advanced life, and caused by a relaxed state of the vessels of the mucous membrane. When the bleeding is moderate, cold air, the application of cold lotions to the nose and forehead, or to the back of the head or neck, and the injection of astringent lotions will be sufficient to control the hemorrhage. When these are not sufficient, bleeding from the arm may be resorted to in the active form of the disease. Should this fail, a plug of lint introduced into the anterior nares will often arrest the hemorrhage. When this is insufficient it becomes necessary to plug the posterior nares, to prevent the blood flowing into the pharynx. This is done as follows :

Pass a silk thread through a gum elastic catheter, introduce this along the nose into the pharynx, draw forwards the extremity of the thread from the mouth, and to its *centre*, attach a piece of sponge sufficient to close the posterior nares. Draw the thread, and with it the attached sponge, back into the mouth, behind the velum, and against the posterior nares, withdrawing the catheter at the same time. One end of the thread will hang out of the anterior nares the other from the mouth. Fasten them together on the side of the face, with sticking plaster. The blood is now forced to collect in the cavity of the nose, it soon coagulates and so arrests the bleeding. The piece of sponge may be removed in twelve to twenty-four hours.

DISEASES OF THE TONGUE.

Inflammation of the tongue (*Glossitis*) sometimes takes place from exposure to cold, mechanical injury, the use of mercury, in small-pox or after fever. The tongue becomes swollen, painful to the touch, and protrudes from the mouth. Respiration and deglutition are much interfered with; symptomatic fever is present. In mild cases, the use of leeches to the tongue, purgative medicines, and diluent drinks will remove the affection, but in the more severe forms, incisions should be at once made into the substance of the tongue; these give almost instantaneous relief. Ulcerations frequently form on the tongue, particularly on its edges and tip, from previous inflammation, the irritation of a broken tooth, or deranged stomach and bowels. In the last instance they are small, numerous, and circular in shape (apthæ), and are usually preceded by small vesicles or pustules. The local application of the nitrate of silver, either in solution or substance, will in general remove the disease, attention being, at the same time, paid to the digestive organs.

Syphilitic ulceration attacks the tongue, generally its dorsum, a little in front of the epiglottis.

The tongue is liable also to *cancer*. This disease may appear first in the form of a hard tumour, a fissure, or an ulcerated spot. It most frequently commences at the side of the tongue, near its root, and presents the usual characteristic symptoms of cancer. It is remarkable for appearing at the earlier periods of life. Extirpation is the only remedy that holds out any prospect of success. Arsenic has been much extolled in malignant ulcers of the tongue. Mr. Earle has described a peculiar affection of the tongue, met with in a boy:

> Clusters of very minute semitransparent vesicles pervaded the whole thickness of the tongue, occupying nearly one half, and projecting considerably, both above and below the organ. The slightest injury caused them to bleed profusely, and in some places the clusters were separated by deep clefts, which discharged a fetid, irritating sanies. This disease, which had resisted various plans of treatment, gradually yielded to strict attention to perfect quiet and cleanliness, combined with large doses of hyoscyamus, which was increased to one drachm of the extract daily.

Diseases of the tonsils (*Cynanche Tonsillaris*). This is an acute inflammation of the tonsils, and appears at almost all periods of life, but more frequently in young persons about the age of puberty, and after one attack is very prone to recur. This attack is usually ushered in as if one of common fever, that is, by shiverings, nausea, and general indisposition. The patient soon experiences a soreness and pain in the throat, which increases rapidly until the disease is fully formed. The tonsils are now swollen, so as to project into the fauces, hard, and exceedingly painful. The patient swallows, and, in many cases, breathes, with difficulty; there is much soreness on each side of the neck, and the glands externally become enlarged. The sense of hearing is sometimes very acute, and even painful, from the extension of the inflammation to the Eustachian tubes, or these may become blocked up, and thus produce temporary deafness. The strictest antiphlogistic regimen should be observed. Leeches applied to the inflamed tonsils have been found very beneficial; free scarifications of the glands are much more so. By active treatment the inflammation sometimes is subdued, but more frequently advances to suppuration, and in general of but one gland. As soon as matter appears to be formed in the gland, it should be opened, if productive of much distress to the patient, but otherwise may be allowed to burst of itself. Abscesses in the tonsils should be opened with much caution, as the internal carotid artery lies but a short distance to the outer side of the gland, and may be wounded. If caution be observed, it is of little consequence what instrument we use, so as it be fitted to the object in view; a sharp-pointed bistoury, covered with adhesive plaster to within a short distance of its extremity, or gum-lancet, or the peculiar instrument manufactured for the purpose, will answer. The point of the instrument in opening the abscess should be directed backwards, or backwards and inwards, on no account outwards, as the artery lies in this direction. The matter being discharged the patient soon recovers. Emetics sometimes are given, with a view to cause the bursting of the abscess during the efforts to vomit. Some have recommended the application of a strong solution of nitrate of silver, the Tinct. Capsici, and other stimulating agents, to the tonsils; when in an inflamed state, the latter are not to be recommended, although useful when the glands are in a state of chronic inflammation.

The tonsils are sometimes permanently enlarged from frequent attacks of inflammation. Their removal under these circumstances has been occasionally practised in order to relieve the patient's deglutition and respiration, which are often seriously impaired by the tumours. They are removed by transfixing each enlarged gland with a double hook, by which it is drawn forwards, and is then cut away with the scalpel, or the cystotome, as recommended by Desault. Sir A. Cooper, who prefers the ligature, gives to an eye-probe the requisite curve, and then passes the ligature with it behind the enlarged tonsil. The probe being then removed, the knot is made with the tonsil irons, if the fingers are found not long enough for the purpose.

The tonsils are liable to ulceration in syphilitic and other affections. Gangrenous inflammation sometimes attacks them, as in scarlatina.

LARYNGOTOMY.

Laryngotomy is the making of an artificial opening in the larynx, between the cricoid and thyroid cartilages; it is performed in the following cases:

Foreign bodies in the pharynx. When a foreign body becomes impacted in the pharynx suffocation is frequently induced by the spasmodic action of the constrictor muscles of the larynx. In cases of this kind, the removal of the substance may be at once effected by the fingers of the surgeon, or by the probang being passed into the pharynx, thus forcing the body to descend into the œsophagus. When these means are not available laryngotomy becomes necessary.

Foreign bodies in the trachea. When small bodies, such as beads, peas, beans, &c. are contained in the mouth, and inspiration takes place, they frequently descend through the rima glottidis into the trachea. They are here productive of some, though not much, irritation, and give rise to occasional fits of suffocation, from being forced upwards, during expiration, against the chordæ vocales. If the body be not expelled by the efforts of the patient, laryngotomy should be performed.

Suffocation from drowning. Death is produced in drowning by the spasmodic closing of the rima glottidis; when we wish to inflate the lungs, it becomes necessary to do so by performing the operation of laryngotomy, or by passing a gum elastic catheter through one of the nares into the larynx. The former method is to be preferred in general, as the introduction of an instrument through the nares into the larynx occupies much valuable time, the loss of which may determine the life of the patient. Laryngotomy is performed as follows:

Place the patient in the recumbent posture, with the head thrown backwards. Make an incision, about half an inch in length, from above downwards, on the mesial line, through the integuments, and between the crico-thyroid muscles; the crico-thyroid ligament is exposed, open into this with the lancet or scalpel. If necessary, as in cases of foreign bodies in the trachea, the incision may be prolonged upwards, through the thyroid cartilage, as far as the attachment of the chordæ vocales, and downwards through the cricoid, as far as the upper edge of the thyroid body. If the foreign body should be impacted in the trachea, a gum elastic catheter may be introduced, and thus the body dislodged.

Tracheotomy or *Bronchotomy* is the operation of opening the trachea immediately above the sternum. It is performed in cases of acute and chronic laryngitis, croup, where children or others have swallowed boiling water, or sulphuric acid, and occasionally in syphilitic affections of the larynx. The operation is performed as follows:

Place the patient in the recumbent posture, with the head and neck extended; make an incision, about two inches and a half in length, on the mesial line, over the trachea commencing at the upper edge of the sternum. In this, the integuments and fascia are cut through, and the knife passes between the sterno-hyoid and thyroid muscles of either side; separate these muscles, and by tearing through some cellular tissue, the trachea will be exposed, having in front of it the thyroid plexus of veins. These should be avoided, as they are large, and will, if wounded, pour out a large quantity of blood, during the flow of which the trachea cannot be opened, as immediate suffocation of the patient would be the result, from the blood being sucked into the trachea. The trachea should now be transfixed with a tenaculum, and a circular portion, including parts of two or three of its rings, removed. This is much better than a simple incision into the tube, as in this, the patient will be obliged to wear a canula to prevent the closing of the aperture, and the presence of this instrument adds much to his sufferings after the operation. The surgeon, in performing the operation of tracheotomy, has to avoid the thyroid gland above, the left vena innominata below, and any irregular distribution of the arteries from the arch of the aorta that may exist; of these the most frequently met with is a middle thyroid artery, which ascends from the arch of the aorta, in front of the trachea to the thyroid gland. In the child this is a much more difficult operation than in the adult, in consequence of the shortness of the neck, the small size of the trachea, its great mobility, the presence of the thymus gland, the contiguity of the large vessels at the root of the neck, and the restlessness of the patient.

Wounds of the Throat are generally made in attempts at suicide. The incision, in these cases, most frequently passes through the thyro-hyoid ligament, into the mouth, immediately above the glottis, dividing the stalk-like process of the epiglottis. The hemorrhage from the wound should first be restrained by securing the bleeding vessels with the ligature. When this has been done, it has been recommended to close the wound with sutures. Mr. Liston very properly advises the wound to be left open for a few days, a piece of thin muslin being placed over, to cover the wound and prevent foreign bodies from entering the trachea. When the wound is closed immediately, the discharge from it passing into the larynx keeps up a constant irritation; and it may happen that a portion of divided muscle or cartilage will close the natural passage altogether, and thus suffocate the patient. It will be necessary to feed the patient through a gum elastic tube, passed through the nares into the œsophagus and stomach.

ON DISEASES OF THE MAMMA.

Inflammation of the Mamma. This, in general, occurs to females within the first three months after parturition, and is caused by the increased action of the vessels of the breast, by exposure to cold, or injury to the breast. The inflammation may attack either the cellular tissue or the glandular structure of the mamma; in the latter, the swelling is irregular, and seems to consist of one or more large tumours. The disease is characterized by heat, pain, redness, and swelling of the breast. The pain is of a very acute, throbbing nature, and often extends to the axillary glands. The redness is either uniform or in irregular patches; the breast soon becomes tense, heavy, and painful to the touch; there is high inflammatory fever. The treatment consists in the administration of purgatives, the application of leeches and fomentations to the breast, and the supporting the mamma. If the inflammation do not subside in four or five days, suppuration may be expected. The matter forms in one or more numerous abscesses, which are best left to nature, unless productive of much distress, when they should be opened: some milk is in general discharged from the abscess with the purulent matter. When the inflammation of one mamma subsides, the opposite breast not unfrequently becomes inflamed. Chronic abscesses occasionally form in the breast, or in the cellular tissue beneath it. They are frequently productive of great distress, from bursting in different points, and from the quantity of matter discharged from the various sinuses that form. Sir A. Cooper advises the sinuses to be injected with a lotion of rose-water, with two or three drops of sulphuric acid to each ounce. Mr. Hey has recommended the division of the sinuses. The milk sometimes collects in a portion of the breast, from an obstruction of some of the lactiferous tubes; the tumour should be punctured with the lancet, and the fluid discharged.

Hydatid or *encysted* swelling of the breast. There are two species of this complaint: the one which contains a fluid, like serum in cells; the other a globular hydatid, such as is found in the liver and other parts of the body. The disease appears most frequently between the ages of fifteen and twenty-five. *Symptoms:* The swelling is first hard; in the second place, contains a fluid; thirdly, is unattended with pain; and, fourthly, there is no particular constitutional irritation, except when ulceration commences, and then it is slight, and need not be alarming to the patient's mind. *Treatment:* If a number of hydatids exist, occupying the greater portion of the breast, the disease will require removal, from its weight and size and the patient's desire to be relieved from it. If there be but one cyst, it may be punctured, and the adhesive inflammation excited in its interior, so as to cause its obliteration. The disease is not malignant.

Scirrhus of breast, see Cancer.

Fungus Hæmatodes of breast, see Fungus Hæmatodes.

Simple chronic Tumour of breast. This disease is not of a malignant nature, and in general appears in single females, before the age of thirty. *Symptoms:* The tumour is exceedingly moveable, and is more diffused in the surrounding substance than scirrhus; it has a lobulated feel, being divided into distinct compartments by septa. It is not painful, except about the period of menstruation. The disease is easily distinguished from cancer, by the absence of the characteristic symptoms of this latter affection, as also by the healthy state of the constitution. *Treatment:* Absorption of the tumour should be promoted by the use of proper remedies externally and internally. If this cannot be accomplished, the tumour may be removed by the knife without trouble.

Irritable Tumour of the breast. This tumour is exceedingly painful and tender to the touch, the pain frequently shooting towards the arm and fingers. This disease also occurs in young females. *Treatment:* Mist.

Ferri comp. and other emmenagogue medicines, exhibited internally.

Cancer sometimes attacks the nipple of the male subject.

INJURIES OF THE THORAX

Consist of wounds and contusions, with or without fracture of the ribs, or other portions of the thoracic parietes.

Wounds of the thorax are divided into, first, those which affect only the skin and muscles; secondly, those which penetrate the cavity, without wounding any of the viscera; thirdly, those which wound the lungs or other viscus.

Superficial wounds of the thorax are treated as superficial wounds in other parts of the body; thus, the edges of the wound are brought together, and made to unite, if possible, by the first intention. The old practice of probing, or otherwise meddling with the wound, to ascertain if it has penetrated the cavity, is done away with; any bad symptoms that may subsequently appear are to be combated by appropriate treatment, as we shall presently point out.

Wounds which penetrate the cavity of the chest, without injuring any of the viscera. Where a wound has penetrated the cavity of the chest, it is usually characterized by pain in inspiration, difficult respiration, and more or less collapse of the patient; the skin being cold and covered with a clammy perspiration, and the pulse quick, weak, and sometimes fluttering. The difficulty o breathing in such cases is produced either by the externa air collecting in the cavity of the chest, or by blood poured into it from a wound of the intercostal artery The air is found to enter the chest at each act of inspi ration, and collects there, part only being forced ou during expiration. Some of the air, as it passes outwards, becomes entangled in the lips of the external wound whence it is soon diffused over the rest of the body, givin rise to general emphysema. As the air will continue t collect and be extravasated in the cellular tissue of th body so long as the external wound remains open, th should be closed as soon as possible, when the extravasated air will become absorbed after some time. Should the dyspnœa be urgent, from the quantity of air collected in the chest, a portion of this may be removed by closing the wound during inspiration, and opening it during expiration. The difficulty of breathing will be still further relieved by taking blood from the arm, by which the lungs will be unloaded, the quantity of blood circulating in them being lessened, and any disposition to inflammation checked. The air, extravasated in the cellular tissue of the body, is productive of no bad consequences, being absorbed in a few days. If the intercostal artery be wounded, it may bleed either externally or into the cavity of the chest: in the former case the injury becomes at once apparent, when the wounded vessel should be secured; in the latter case, the blood flows into the cavity of the chest, where it may collect in large quantities before the injury is suspected, as the symptoms produced by the loss of blood may be readily confounded with those connected with the wound of the chest. If a portion of card be now introduced into the wound, the blood will flow along its surface, and so appear externally. Under these circumstances, the bleeding vessel should be at once secured with the ligature; and when this cannot be accomplished, from the artery being lodged in the groove in the edge of the rib, a compress, or piece of prepared sponge, with a ligature attached, to prevent its passing into the thorax and admit of its removal at a future period, should be introduced into the wound, so as to compress the bleeding vessel. We can resort to no means for the removal of the blood collected in the chest, as it sinks to the lower part, and becomes coagulated; we must therefore trust to its being absorbed. As, in this case, the pleura is wounded, we have to apprehend inflammation of it; any appearance of this should therefore be combated by the most active antiphlogistic regimen.

Wounds in which the lungs are injured. In addition to the symptoms enumerated, as connected with a merely penetrating wound of the chest, and which are aggravated in this case, we have a spitting of blood, unless the wound of the lung be very superficial indeed. The blood spit up is of a bright red colour, frothy, and mixed with bubbles of air; air mixed with blood may also escape from the external wound. Bleeding becomes, in this case, our principal remedy, as by it we accomplish three objects, namely, lessen the quantity of blood circulating in the lung, thereby relieving the difficulty of respiration; check the flow of blood from the wounded vessel by lessening the action of the heart and arteries, or by producing fainting; and, lastly, provide against inflammation. As the lung is wounded, there is still greater danger from emphysema, as the air will escape from the wounded lung into the cavity of the chest, and thence over the body, and will also make its way into the cellular tissue of the lung, passing over to the lung of the opposite side, then compressing the air-cells, and impeding or wholly stopping respiration. In deep wounds, emphysema of the lung is not so likely to take place as in superficial, as the quantity of blood effused into the cellular tissue of the lungs prevents the ingress of the air. Deep wounds are, however, more dangerous, from the larger blood-vessels being injured. In cases of wounded lung, we have to guard against inflammation of the lung, at a more distant period. Gun-shot wounds of the lungs, if not immediately fatal, may be so ultimately, from hemorrhage arising when the sloughs are separating from the course of the ball, and from inflammation, or chronic disease of the organs supervening.

Contusions of the thorax are seldom serious, except when some of the thoracic viscera have been injured. Sometimes one or more of the ribs are fractured, either by violent blows or heavy bodies passing over the chest. The seventh, eighth, or ninth ribs are more frequently fractured than the others, from their greater length, and being less protected; they usually give way in front of their angles, between this point and their anterior extremities. As the broken ribs are moved in the act of respiration, the bony spiculæ, if not previously driven into the lungs by the violence which caused the fracture, frequently wound these organs afterwards. In these cases, emphysema of the lungs, as well as of the body in general, appears as the air escapes from the wound of the lung into the cavity of the chest, and is thence expelled into the cellular tissue of the lungs, and by means of the wound in the thoracic parietes into the general cellular tissue of the body. This fluid may also pass directly from the wounded air-cells into the interlobular cellular tissue. The treatment of this accident consists in placing a bandage round the thorax, so as to fix the ribs, especially the broken ones, in order that they may be prevented from doing further injury to the lung, and be allowed to unite, inspiration being carried on solely by the diaphragm, and in the free abstraction of blood, to lessen the quantity circulating in the lungs, and prevent the supervention of inflammation.

The operation of *paracentesis thoracis*, or tapping the thorax, is now never resorted to for the purpose of abstracting the air from the cavity of the chest, as the most dangerous symptoms are not produced from its presence in this situation, even although it should be in such quantity as to compress the lung of that side, but from its escaping into the cellular tissue of the wounded lung, whence it may pass across the mediastinum to the sound lung. The only cases in which this operation is at present resorted to are empyema, where a collection of matter has formed in the chest, and some cases of hydro-thorax. It is performed as follows.

Place the patient in the sitting posture, with the arms folded across the chest; examine if the matter point at any particular part, if it should the opening is to be made here; if not, the interval between the fifth and sixth ribs, or between the sixth and seventh, should be selected: the former is best on the right side, in consequence of the contiguity of the liver; the latter is to be preferred on the left, in order to avoid the heart and pericardium. Draw up the integument and make an incision, about two inches in length, a little above and parallel to the upper edge of the lower rib, that the intercostal vessels may not be endangered; and passing through the skin and outer layer of intercostal muscles, next divide the inner intercostals, and having thus exposed the pleura, make a small opening into it with the scalpel, or with the trocar and canula; the fluid is now drawn off. The incision should be made about a hand's breadth below the inferior angle of the scapula, and the same distance from the spine; by so doing we avoid the lumbar muscles posteriorly, the serratus and pectoral muscles in front. Some pass the trocar and canula into the chest, without any previous division of the soft parts; it is objectionable, as the lung may be adherent at that particular part, and will thus be wounded. The matter having been evacuated, the skin is to be drawn down, so as to render the opening oblique, and thus more completely exclude the atmospheric air, and the edges of the wound are to be brought together by adhesive plaster.

WOUNDS OF THE ABDOMEN

Are divided into, first, those which affect only the parietes; second, those which penetrate its cavity; third, those which injure some of the contained viscera.

Superficial wounds, or those which affect only the parietes, are treated as superficial wounds in other parts of the body. Sutures will be found more efficacious in retaining the edges of the wound in apposition, and preventing the protrusion of the abdominal viscera, than adhesive plaster; they should be passed through the skin only, and be supported by compresses and bandages. As peritonitis may ensue, they require careful watching. In cases where the sheath of the rectus muscle has been wounded, inflammation of this structure has followed, and abscesses have been the result. These should be opened early.

Wounds which penetrate the cavity of the abdomen are known by a protrusion of some of the viscera, and where this does not occur by the introduction of the finger, or a probe, and generally, but not always, by the extreme debility and faintness of the patient. They are treated as superficial wounds, peritonitis being still more carefully guarded against. The intestines, if protruded, should be cleansed from all foreign matter, and then returned. Where this cannot be accomplished, the wound is to be dilated, and at its upper rather than its lower extremity. That portion of the intestine which has last protruded should be first returned, and the intestine before the omentum.

Wounds which injure some of the contained viscera. These accidents are distinguished by the protrusion of the wounded viscus, when the injury is at once obvious;

and where this is wanting, by the escape from the wound of some of the contents or secretions of the viscus, and the passage of blood per anum, or by the mouth, as in wounds of the stomach. These symptoms are, in general, combined with great debility and faintness of the patient; but, as such symptoms may be present in simply penetrating, or even superficial wounds, they are not of themselves indications of any of the viscera having been wounded. The treatment of this accident consists in closing the wound in the viscus, if it be one of the intestines that is injured, by one or more points of the interrupted suture, returning the intestine, and bringing the edges of the wound together. In the course of a few days, an encysted abscess forms around the ligatures, which separate and escape, with the contents of the abscess, into the cavity of the intestine, and are thus discharged. Where the wounded intestine cannot be so secured, nature accomplishes a cure by an effusion of lymph around the wounded portion of intestine, which limits, or altogether prevents, the escape of matter from its cavity. Strict rest and the antiphlogistic regimen should be observed, in order to guard against peritonitis. Purgatives, as exciting the action of the intestines, should be avoided for a few days after the accident. Penetrating wounds of the abdomen prove fatal, either from peritonitis or from hemorrhage, where a large blood-vessel has been injured.

HERNIA.

The term hernia is made use of in surgery to indicate the protrusion of any viscus from its containing cavity; but generally implies an escape of one or more of the viscera of the abdomen.

Several divisions have been made of this disease. That in most general use is according to the region of the abdomen in which the hernia appears. In this division we have several species, namely, *inguinal*, *femoral*, *umbilical*, *ventral*, *obturator*, *diaphragmatic*, *perineal*, *vaginal*, *pudendal*, and *sciatic*.

Inguinal hernia is so called from its appearance in the inguinal region or groin: we have two varieties of it, one named *oblique*, from following the course of the spermatic chord, whence it is also occasionally called spermatocele; the other is called *direct*, from its protruding directly forwards through the external abdominal ring.

Femoral hernia appears in the upper, inner, and anterior part of the thigh, where it descends beneath Poupart's ligament, on the inner side of the femoral vessels.

Umbilical hernia protrudes through the umbilicus, taking the course of the umbilical chord.

The term *ventral* hernia indicates the protrusion of one or more of the viscera through some other region of the abdomen than those specifically mentioned; the situations where this species of hernia most frequently occurs are the linea alba and the lineæ semilunares. The other forms of the disease are of minor importance; they are sufficiently indicated, for the present, by their names.

Another division of hernia, and one which is of essential importance in practice, has arisen from the different conditions in which the tumour may happen to be; thus it may be either *reducible* or *irreducible.*

Reducible hernia is that species which can be returned into the abdomen.

Irreducible hernia may be either *simply irreducible*, *incarcerated*, or *strangulated.*

Simply *irreducible hernia* is that species which, from adhesions or other causes, cannot be returned into the abdomen, yet is at the same time unattended by any dangerous symptoms.

In *incarcerated hernia* a certain degree of constriction exists on either the intestines or omentum, which interferes partially with the functions of the viscera, but not so as to bring the life of the patient into immediate danger.

Strangulated hernia is one of the most formidable diseases the surgeon has to contend against; in it a stricture exists which, pressing on the protruded viscera, produces a train of violent symptoms, which if not speedily relieved will terminate fatally.

From the nature of the contents of the hernial tumour, another division has been made. When the tumour is wholly composed of intestine, it is named *enterocele*; of omentum, *epiplocele*; and where it consists of both intestine and omentum, *entero-epiplocele*.

In addition to these we meet with congenital and infantile hernia. These are modifications of the inguinal species.

INGUINAL HERNIA

Is by far the most frequent of all, at least in the male subject, in consequence of the greater extent of the inguinal or spermatic canal in this sex; in the female, on the contrary, femoral hernia is more frequent, from the greater breadth of the pelvis, and the consequently greater extent of the femoral ring.

OBLIQUE INGUINAL HERNIA.

In this form of the disease, the hernia takes the course of the spermatic canal, with the spermatic chord; that is, it escapes from the abdomen at the internal abdominal ring, about midway between the spine of the ilium and the symphysis pubis, descends obliquely forwards and inwards, escapes throughout the external abdominal ring, and finally descends into the scrotum.

To dissect this species of hernia, place the subject on the back, extend the limbs, and put a support beneath the pelvis. Make a vertical incision through the integuments, from the umbilicus to the symphysis pubis; from the upper extremity of this carry another incision, downwards and outwards, to the spine of the ilium. Carefully raise the skin, commencing at the umbilicus, and throw downwards, on the thigh, the triangular flap thus formed. On doing so, a dense layer of cellular substance is brought into view; this is the *superficial fascia* of inguinal hernia. This is perfectly continuous with the common subcutaneous cellular tissue beneath the integuments in other regions of the body, and differs but little from it, except in being a little denser in structure, and of more importance from its connexion with hernia. *Above*, the superficial fascia is continuous with the cellular tissue covering the lower surface of the thorax, and upper part of the abdominal muscles. *Inferiorly*, it descends over Poupart's ligament into the thigh, and there becomes continuous with the superficial fascia of the femoral region; nearer the pubes it passes over the spermatic chord in the male, and descends into the scrotum and perineum, where it identifies itself with the loose cellular tissue of these regions. On the *mesial* line, the superficial fascia descends from the linea alba on the dorsum of the penis, and here forms a tolerably dense structure, the false suspensory ligament of the penis, which connects this organ to the abdominal parietes. In the female it is loaded with a quantity of adipose tissue, and descends into the labia. The cutaneous surface of the superficial fascia is rough and cellular, and is intimately connected with the integuments; its deep surface is more compact and smooth, and is applied against Scarpa's fascia, which thus separates it from the abdominal muscles. The use of this fascia is to allow of the free motions of the integuments on the abdominal muscles, and to assist these in the support of the abdominal viscera.

Some anatomists have divided the superficial fascia into several layers; this is quite an arbitrary division, and without any practical advantage, as the number of layers varies in almost every subject, and depends much on the dexterity of the operator. In it we meet with several superficial arteries, veins, nerves, and lymphatic glands. The *arteries* are the external epigastric, and branches from the external circumflexa ilii, and pudic arteries. They arise from the femoral artery a little below Poupart's ligament, ascend in front of the ligament, and are lost in the superficial fascia and integuments. The external epigastric is the largest, it ascends obliquely inwards, towards the umbilicus, where it terminates. One or more of these vessels are in general wounded in the operation for the relief of strangulated inguinal hernia; the hemorrhage is easily restrained. The *veins* accompany the arteries. The *nerves* are small, and are derived from branches o the lumbar plexus. The *lymphatic glands* are four or five in number; they take a nearly transverse course, parallel to Poupart's ligament, some lying a little above others somewhat beneath the ligament. They are named the *superior* inguinal glands, to distinguish them from another set of inguinal glands, met with below Poupart's ligament, more numerous and arranged in the vertical direction; they are contained in a sheath or capsule formed in the superficial fascia. The superior set communicate with the absorbents of the genital organs, hence they become inflamed in all diseases affecting these parts; not unfrequently, too, some absorbents from the perineal and anal regions communicate with them, and thus swelling may be induced in them from disease of these parts. The *inferior* inguinal glands, on the contrary, communicate with the absorbents of the lower extremity. Chronic enlargement of these glands may be mistaken for an inguinal or femoral hernia.

Raise the superficial fascia from beneath, commencing a little below Poupart's ligament, and continue the dissection upwards to the umbilicus. A distinct layer of cellular tissue, "Scarpa's fascia," is exposed. This is firmly attached to and appears to arise from the fascia lata, about half an inch below Poupart's ligament, whence it ascends over the ligament, to be gradually lost on the outer surface of the external oblique muscle; it is sometimes described as the deep layer, of the superficial fascia, with which it is so intimately connected, as to give to this the appearance of being firmly attached to Poupart's ligament; they are, indeed, with difficulty separated. In London, usually no distinction is made between this and the superficial fascia.

On Scarpa's fascia femoral hernia rests, when it turns up over Poupart's ligament. These fasciæ, excepting the skin, form the most superficial coverings of an inguinal hernia. From the free communication between the cells of the superficial fascia and those of the surrounding cellular tissue, fluids are rapidly transmitted from one to the other: this is particularly manifest in anasarca and extravasations of urine.

On raising Scarpa's fascia the outer surface of the external oblique muscle is brought into view: this is here perfectly tendinous, in order that it may the more effectually support the abdominal viscera; it forms, with its fellow of the opposite side, a broad sheet of tendon, extending directly across the lower part of the abdomen. Each tendon is somewhat triangular in shape; one margin is turned inwards, and unites with its fellow on the mesial line, to form the linea alba; a second is directed upwards and outwards, slightly concave, and gives attachment to the fleshy fibres of the muscle; the third margin is turned downwards and outwards; and here presents a thickened condensed chord, named Poupart's ligament.

The tendinous fibres of the external oblique muscle take a direction downwards and inwards; a few may be observed to decussate with these, taking an oblique course upwards and inwards. As we trace them towards the pubes, they increase in strength and density; and, having arrived within about an inch and a half of this bone, they separate into two bands, and thus leave an interval between them, named the *external abdominal ring*. The bands are named the pillars of the ring. One of them, the *internal*, lies *anterior* and *superior* to the other; it is a broad flat sheet of tendon, which, passing inwards, descends in front of the symphysis pubis, into which it is implanted, decussating with its fellow of the opposite side. A few fibres pass from it to be continuous with the fascia lata of the opposite side; others may be traced descending on the dorsum of the penis, contributing to form the true suspensory ligament of this organ. The *external* pillar of the ring, stronger and shorter than the other, is a continuation of Poupart's ligament: it is a round fibrous chord, descends inwards, and is inserted into the spine or tubercle of the pubes; on it the spermatic chord rests as it escapes through the ring.

Inferiorly, or towards the thigh, the *descending* fibres of the external oblique muscle become condensed, and form *Poupart's ligament*, a dense fibrous chord, which descends inwards from the anterior superior spinous process of the ilium to the pubes, into which it is implanted by two attachments: one, already described as the external pillar of the ring, is inserted into the spine or tubercle of the pubes; the other is an expansion from this, and forms a broad thin ligament, which ascends obliquely inwards, to be inserted into the internal extremity of the linea innominata; it is named *Gimbernat's ligament*, or the third insertion of the crural arch. It lies superior and posterior to the external pillar of the ring, or second insertion of Poupart's ligament.

Near the ilium, Poupart's ligament is thin and weak, but it increases much in density as it approaches the pubes. Its *inferior* margin, slightly concave, and directed somewhat forwards, gives attachment to the iliac portion of the fascia lata. To its *superior* edge are connected the external and internal oblique and transversalis muscles, and the transversalis and iliac fasciæ. By some this ligament is described as a distinct structure. It is of use in strengthening the abdominal cavity inferiorly, and thus preventing the protrusion of the viscera; it also affords attachment to muscles and fasciæ, and protects the femoral vessels and spermatic chord. From its connexion with so many fasciæ, it is particularly necessary, in all our attempts at the reduction of hernia, that Poupart's ligament should be as relaxed as possible; this is best accomplished by bending the upper part of the body, so as to relax the abdominal muscles, and at the same time flexing and rotating the thigh inwards, in order to relax the fascia lata; in some subjects it is very indistinct, and can with difficulty be discovered during life.

A few tendinous fibres of the external oblique muscle decussate with those just described; they are the intercolumnal bands. They arise from near Poupart's ligament, ascend inwards, forming curves, convex towards the pubes, and are gradually lost in the tendon as they approach the linea alba; towards the ilium they are indistinct, but near the pubes they become strong and well marked; in general, one stronger than the rest rounds off the apex of the external abdominal ring, and thus assists in restraining the increase of this opening. The use of the intercolumnal bands is to prevent the separation of the descending fibres of the external oblique, between which, intervals occasionally exist, exposing the fibres of the internal oblique muscle.

Hitherto the external abdominal ring has not been sufficiently apparent; it is concealed from view by a layer of cellular tissue, the *external* spout-like or *Camper's fascia* or *intercolumnal fascia*, which descends from the edges or margins of the ring, on the spermatic chord, upon which it is insensibly lost. Some describe this fascia as being derived from the intercolumnal bands. Scarpa considers it to be a prolongation of the fascia which has received his name. It is so intimately connected with all these structures, that it is impossible to assign to it any distinct origin. It forms the third covering of an inguinal hernia, whether oblique or direct.

On dissecting off this fascia, the external abdominal ring is exposed. This is an opening in the external oblique tendon, formed by the divergence of its *descending* fibres; it transmits the spermatic chord in the male, the ligamentum teres in the female. It is triangular in shape; the *apex*, directed upwards and outwards, is rounded off by the intercolumnal bands; its *base* inferiorly is formed by the crest of the pubes; its *internal* margin, the longest, is formed by the internal pillar of the ring; its *external* margin by the external pillar; its greatest length corresponds to that of its internal margin, and varies from one inch to one inch and a half; it is the outer or anterior opening of the inguinal or spermatic canal; through it an inguinal hernia emerges, to descend into the scrotum.

If the spermatic chord be now cut across, a little beneath the ring, and gently raised, it will be seen that it has escaped through this aperture, resting, not on the bone, but upon the external pillar of the ring, and that, behind the external abdominal ring, some fibrous structures exist, which assist in preventing the protrusion of hernia through this opening, directly from behind, or, in other words, prevent the formation of a direct inguinal hernia: these are *Colles's fascia*, and the *conjoined tendons.*

Colles's fascia, more commonly named the *triangular ligament of inguinal hernia*, is liable to much variety, being in some subjects well marked, in others altogether wanting; it lies behind the external abdominal ring, in front of the conjoined tendons, and partially concealed by the internal pillar of the ring. It is formed by a few fibres, which are derived from the posterior surface of the external oblique tendon of the opposite side; the ligaments of either side therefore decussate. Its base is implanted into the crest of the pubes; one margin is towards the linea alba, the other is free, and looks upwards and outwards.

The *conjoined tendons* lie behind and to the outside of the preceding: they are the united tendons of the internal oblique and tranversalis muscles, which here pass in front of the rectus muscle, to be inserted into the upper part of the symphysis and crest of the pubes; the external margin of the conjoined tendons is prolonged beyond the outer edge of the rectus muscle; it here is inferiorly implanted into the linea innominata, where it is continuous with Gimbernat's ligament. Above this the transversalis fascia is implanted into it; here, indeed, the two structures frequently appear to be continuous one with the other.

From the great strength and transverse extent of the conjoined tendons, and their position immediately behind the external abdominal ring, they contribute much to the security of the abdomen in this situation, and thus prevent the formation of direct inguinal hernia.

Inguinal or *spermatic canal.* This is an oblique canal or passage between the abdominal muscles, which transmits the spermatic chord in the male, the ligamentum teres in the female; it possesses two openings, one at either end, named the abdominal rings: one of which, the external, we have already described; the other, the internal, is situated about midway between the symphysis pubis and the spine of the ilium, and is as yet concealed from view. Divide the tendon of the external oblique from the external abdominal ring, upwards and outwards, towards the ilium, parallel to and a little above Poupart's ligament; the greater part of the inguinal canal is now exposed, together with the spermatic chord. This latter presents here a flattened appearance, having its component parts partially spread out, so as not to suffer from the action of the abdominal muscles.

The *inguinal* or *spermatic canal* commences at the *internal abdominal ring*, as yet concealed from view by the lower margin of the internal oblique muscle. This is an opening in the transversalis fascia, situated about midway between the spine of the ilium and the symphysis pubis, but somewhat nearer the former, about three quarters of an inch above Poupart's ligament; from this the canal descends forwards and inwards between the oblique muscles, and terminates at the external abdominal ring. Its length is about one inch and a half, if we measure the distance between the two nearest points of the two rings; three inches, if we measure between the two furthest points of these openings; and two inches and a half, if we measure between the intermediate points.

The inguinal canal is bounded,

Above, by the lower margins of the internal oblique and transversalis muscles.
Below, by Poupart's ligament.
In front, by the external oblique tendon and the lower margin of the internal oblique.
Behind, by the transversalis fascia, the conjoined tendons, Colles's fascia, and occasionally a few fibres of the internal oblique.

The *superior boundary* of the inguinal canal is formed by the lower margins of the internal oblique and transversalis muscles: these muscles are here intimately connected, particularly as we approach the pubes; towards the ilium they are partially separated. Beneath the internal oblique, the spermatic chord may be seen to emerge as it descends; a few muscular fibres pass off along with it, which form the cremaster muscle. In some subjects a different arrangement exists, which is, that the spermatic cord passes out between the fibres of the internal oblique, some of which thus lie beneath the chord: this structure then escapes through a perfectly muscular opening. Now, as hernia takes the same course as the chord, it follows that the tumour, escaping through a muscular aperture, will be much exposed to constriction; hence one of the reasons why the stricture is so frequently met with in strangulated oblique inguinal hernia, at the lower margin of the internal oblique muscle. In this stage of the dissection, the extent of origin of the internal oblique muscle from Poupart's ligament may be observed; it in general arises from the external two thirds and upper surface of the ligament, but is liable to much variety in this respect; the fibres descend inwards, to terminate in the conjoined tendons.

The *cremaster* muscle arises not only from the lower margin of the internal oblique, but takes a few fibres from the transversalis muscle, from the neighbouring surface of Poupart's ligament, and from the pubes a little external to its tubercle; from these different origins, its fibres descend around the spermatic chord, but chiefly on its outer and anterior surface, forming a series of loops, the concavities of which are directed upwards, and are finally implanted into the outer surface of the tunica vaginalis, and into the scrotum, to the lower part of which they descend. Between the fibres of the muscle, the *spermaticus superficialis nerve*, a branch from the ilio-scrotal, descends, to be lost in the coverings of the testis. The cremaster muscle is of use in supporting and raising the testicle; it is seldom well marked, except in cases of old hernia, hydrocele, or diseases of the testis, when its fibres become strong and distinct; it forms the fourth covering of an oblique inguinal hernia.

Poupart's ligament bounds the inguinal canal *inferiorly*. Near the internal ring, the chord is about three quarters of an inch above Poupart's ligament, but, as it descends, it gradually approaches the ligament, until at length it lies embedded in its upper surface, which is grooved for its protection. This close relation between the chord and Poupart's ligament should not be forgotten in our operations for the relief of strangulated femoral hernia, as the chord is much endangered, should we adopt the proposal, recommended by some, of cutting directly upwards.

The *anterior* boundaries of the inguinal canal have been already described. Its *posterior* walls are the fascia transversalis and the conjoined tendons: this latter structure forms but a small portion of the posterior boundary of the canal; it lies behind the external abdominal ring. The *transversalis fascia* will be better seen immediately.

Cut through the lower margin of the internal oblique muscle, and raise it gently from the outer surface of the transversalis; the remainder of the inguinal canal will then be still further exposed, as also the *internal abdominal ring.*

This opening is formed by the passage of the spermatic chord through the transversalis fascia. As the chord passes through the fascia, it draws with it, as it were, a cellular prolongation from the fascia: this descends, and is gradually lost upon the chord; it is named the *fascia propria*, or *internal spout-like fascia.* It forms the fifth, or the immediate covering of the hernial sac, hence its name of *fascia propria*, and is also frequently known as *fascia spermatica.* It is well exposed by gently drawing downwards the spermatic chord.

Dissect off the fascia propria, and the internal abdominal ring, although less defined than the external, is completely exposed. It is the inner opening or commencement of the inguinal canal; it may be now seen to be a little nearer the ilium than the symphysis pubis, its inner margin being precisely midway between these two points; it lies nearly opposite the external iliac artery, and about the half or three quarters of an inch above Poupart's ligament. Directly *above* it the lower fibres of the transversalis muscle cross from their origin, from the external third or half of Poupart's ligament, almost transversely inwards, to become identified with the internal oblique muscle, and implanted with it into the conjoined tendons. Occasionally, as Mr. Guthrie has described, a few fibres of the transversalis muscle pass behind the chord. Along the *internal* and *inferior part* of the internal ring, and contained in the transversalis fascia, ascends the epigastric artery.

This artery arises from the external iliac, a little above

Poupart's ligament; it at first descends, then curves upwards, winding round the cul-de-sac of the peritoneum, and then ascends inwards, enters the sheath of the rectus muscle, and terminates by anastomosing with the internal mammary artery. It lies about *a quarter of an inch* distant from the chord.

From the relation of this artery to the internal ring, it is necessarily much endangered in dividing the stricture in cases of strangulated inguinal hernia, as the neck of the sac is only separated from the artery by the spermatic chord; hence arises the never-to-be-forgotten rule, of dividing the stricture in cases of *oblique* inguinal hernia *upwards* and *outwards*, in cases of *direct* inguinal hernia *upwards* and *inwards*, and in *doubtful* cases directly *upwards*. The epigastric atery is accompanied by one or two veins; if by one, the vein lies to its inner or pubal side; if by two, the artery lies between the veins.

Having attentively examined the relative anatomy of the internal abdominal ring, we may now proceed to consider the *transversalis fascia*. This is a layer of condensed cellular tissue or fascia, situated between the transversalis muscle and the peritoneum, and particularly well marked *inferiorly*, where the internal oblique and transversalis muscles are deficient. It may be examined from without, by raising the transversalis muscle, or from within, by detaching the peritoneum.

Superiorly, the transversalis fascia is gradually lost in the loose cellular tissue which connects the peritoneum on its anterior and posterior surfaces to the abdominal parietes, but *inferiorly* becomes strong and well marked. Here, on the *outer* side, it is attached to the inner edge of the crest of the ilium; more *internally* to Poupart's ligament, behind which it unites with the fascia iliaca to prevent the protrusion of hernia beneath this ligament; still more internally, or opposite the femoral vessels, it descends into the thigh, forming the *anterior* layer of the canal in which these vessels are lodged; still nearer the pubis, it is attached to the conjoined tendons, and the outer edge of the rectus muscle, a layer of it passing also behind this muscle to be continuous with that of the opposite side.

At the point where the spermatic chord perforates the transversalis fascia, namely, the internal abdominal ring, the fascia frequently presents a well-defined semilunar border, which bounds the ring to its inner side; in other cases it terminates gradually in this direction: in all instances a prolongation is derived from it, which descends on the spermatic chord, and forms the *fascia propria*, or *fascia spermatica* of *Sir A. Cooper*. Some anatomists describe the transversalis fascia as being composed of two layers, between which the epigastric artery ascends; one of these being attached to the edge of the rectus muscle, the other passing behind the muscle to the opposite side. The transversalis fascia is of use in strengthening the abdominal parietes inferiorly, where a deficiency exists in the internal oblique and transversalis muscles. From its connexion with the transversalis and rectus muscles, it is made tense by the action of these, and is thus rendered still more capable of opposing the protrusion of a hernia.

Through the inguinal canal an oblique inguinal hernia descends, and, as it passes downwards, it receives the different coverings we have described.

Thus, the hernia is first protruded against the internal abdominal ring, pushes before it the peritoneum, which forms the hernial sac; emerging through the internal ring, it descends in front of the spermatic chord, and here receives a covering from the fascia propria; descending still further, it escapes beneath the lower margin, or between the fibres of the internal oblique muscle—here it enters the sheath of the cremaster muscle, and continues its course to the external abdominal ring; it now, turning forwards, passes through this opening, where it becomes invested by the external spout-like fascia; it now descends into the scrotum, covered still further by Scarpa's fascia, the superficial fascia, and the integuments. It thus is covered by the *integument*, the *superficial fascia*, *Scarpa's fascia*, the *external spout-like fascia*, the *sheath* *of the cremaster muscle*, the *fascia propria*, and the *peritoneum*, forming the hernial sac.

Scarpa's fascia is often omitted in the description of the coverings.

As a hernia descends into the scrotum, beneath the coverings of the spermatic chord, it finally arrives immediately above the testis, in which position it is retained by the attachment of the spermatic coverings to the upper and back part of this organ, where its vessels and nerves enter.

The principal points to be attended to, in the anatomy of oblique inguinal hernia, are, 1st, its *coverings;* 2d, the part of the canal where stricture most frequently occurs; 3d, its relation to the epigastric artery, the spermatic chord, and the testis; 4th, the varieties occasionally met with in this disease.

From the distinct enumeration we have just given of the coverings of an oblique inguinal hernia, it might be concluded that a surgeon, when called upon to operate for the relief of a strangulated hernia, should meet with little difficulty in exposing the hernial sac, being enabled from his knowledge of anatomy to cut through layer by layer, with the same accuracy as he could turn over the leaves of a book. Such is not the case: these parts are so liable to vary as to extent and structure, and are so frequently matted together by the adhesive inflammation, that the practitioner, however perfect he may be in anatomy, is obliged to proceed with the greatest caution, dividing layer after layer, as they appear, and can in no instance, *à priori*, ascertain the depth of the hernial coverings; in some, the motions of the intestines may be seen through the parietes; in others, the superficial fascia alone is nearly an inch thick.

The *seat of stricture* in oblique inguinal hernia has now been fully ascertained to be in general either at the lower margin of the internal oblique muscle, or at the internal abdominal ring; and this we should have been led to expect, from the muscular relations of these parts; at the same time, it should be recollected, that the stricture is not unfrequently met with in the neck of the hernial sac, from the thickening produced in the peritoneum by the pressure exercised upon it, and in old cases of hernia may be at the external abdominal ring. Indeed, the hernia may be strangulated in the interior of the sac, by the intestine perforating the omentum, or by an adventitious band of lymph. Such a state of parts has been found in the cavity of the abdomen, when no hernia whatever has been formed, thus causing an internal strangulation beyond the power of surgery.

The *epigastric artery* is the only vessel of consequence endangered in dividing the stricture, and this only when the constriction exists in the interior of the inguinal canal. At the internal abdominal ring this vessel lies *internal* and *inferior* to the neck of the sac, whence it ascends higher than the hernia, still to its inner side: to avoid it, therefore, we should cut upwards and outwards; if we incline the knife *inwards*, there is but little chance of the artery escaping. Some surgeons speak of the *spermatic artery* being also endangered; this is hardly possible, as the vessel lies beneath the hernia throughout, and could be wounded only by cutting downwards, unless in old cases of hernia, where the component parts of the chord are spread out, so as to admit of the descent of the hernia between them, the spermatic artery may be then found in front of the hernial sac, and thus may be wounded. The other parts of the chord, viz. the vas deferens, spermatic veins, nerves, &c. in such cases, are also liable to displacement, so that the hernia may finally make its way behind the spermatic chord altogether; in these cases, as it descends it escapes behind the testis, and thus may be found below this organ.

We have already anticipated a good many of the *varieties* met with in the economy of oblique inguinal hernia; of these the most prominent are the *seat of stricture*, its *relations* to the *chord* and *testis;* the non-existence of a distinct hernial sac, as occurs in protrusion of the cæcum and bladder, and in congenital and infantile hernia; and the complications, caused by the presence of other diseases.

OPERATION FOR THE RELIEF OF STRANGULATED INGUINAL HERNIA.

The usual remedies for the relief of strangulated hernia having been resorted to without success, the surgeon has no alternative; he must proceed to the operation.

We should in all cases take care not to postpone the operation to too late a period, as the symptoms, in many cases, run rapidly to a fatal termination, and gangrene may have supervened before the practitioner has even thought of its occurrence. In such a case the operation is not only useless but injurious; it hurries the fatal catastrophe, and casts a stain on the practitioner and his profession. We should here content ourselves with cutting into the tumour, so as to give exit to its contents, and permit of the separation of the sloughs, and then trust to nature, aided by art, for the establishment of an artificial anus, and the possible recovery of the patient.

In strangulated hernia, the *urgency* of the symptoms must be our guide, as one case may be fatal in a few hours, whilst another may recover a strangulation of a week's duration. In making use of the words urgency of the symptoms, we do not merely allude to their acuteness, for, in some, and particularly in old persons, the disease may terminate fatally by the constitutional irritation it induces, without any very violent symptoms.

We must also be certain that the disease for which we are about to operate is *hernia*, and in this case oblique inguinal hernia, as many diseases may be confounded with it. *Hydrocele* of the *tunica vaginalis* presents many of the characters of inguinal hernia, especially when the fluid reaches as far as the external abdominal ring. We may be enabled to distinguish between them in the following manner: A hydrocele commences from below, a hernia from above; its shape is pyriform, the base beneath; a hernia is more elongated. Hydrocele is in general transparent; in it the spermatic chord may be distinctly felt below the external ring, by grasping it between the finger and thumb, and gently rolling it at the same time; the testis lies to the upper and back part of a hydrocele, beneath the tumour in a hernia. Still the diagnosis is in some cases difficult, from the varieties occasionally observed in both affections.

A hydrocele may be *combined with* an inguinal hernia; in this case the hernia will lie behind the hydrocele, consequently the operator is obliged to discharge the fluid (if the tumour be large), and then cut through the tunica vaginalis to the hernial sac.

A *varicocele* or *spermatocele*, a varicose state of the spermatic veins, has been frequently mistaken for a hernia; the diagnosis is simple. Place the patient in the recumbent posture, reduce the tumour, make pressure on the external abdominal ring, desire the patient to stand up: if the disease be a hernia, it will not reappear; but if a varicocele, the pressure will rather increase it.

Hydrocele of that part of the *spermatic chord* which is contained in the inguinal canal is with some difficulty distinguished from hernia. Sir A. Cooper states that our diagnosis fails here. The tense state of the hydrocele, and the absence of constitutional symptoms at the same time, will assist us; should these latter be present, as sometimes occurs when peritonitis sets in, the hydrocele will not participate in the inflammation of the peritoneum.

Enlargement of the inguinal glands sometimes confuses the practitioner; here the absence of impulse on coughing, the position of the enlarged glands on the outer surface of the external oblique tendon, their circumscribed shape, or else their fluctuation, if matter have formed, will enable us to decide. *Chronic abscesses*, connected with carious vertebræ or diseased hip-joint, sometimes point in the inguinal canal: the symptoms attending these diseases, and the fluctuation of the matter in the abscess, will point out their nature.

From the necessity there exists of our avoiding the epigastric artery in operating for the relief of strangulated inguinal hernia, it is always desirable to ascertain, à priori, whether the disease is by *oblique* or *direct* descent. In general, the oblique course of the tumour along the inguinal canal in the former will at once point it out; but this means of diagnosis is not always present: as in oblique inguinal hernia of long standing the inguinal canal becomes obliterated, in consequence of the internal abdominal ring being drawn down behind the external ring, by the weight of the hernial tumour; here the hernia passes directly backwards into the abdomen, as in the direct species. Should we be then unable to decide, our rule is, in dividing the stricture, to cut directly upwards; we thus avoid the epigastric artery.

The operation is performed in the following manner:

The hair having been first removed from the pudenda, the patient is to be placed in the recumbent posture, having his head and shoulders supported with pillows, and his legs hanging over the end of the table, with his feet resting on two chairs, or held by assistants.

Commence the first incision immediately above the external abdominal ring, continue it downwards, along the mesial line and anterior surface of the tumour, to the bottom of the scrotum, so that no bag may be left for the receipt of the discharges; in this incision, the integument and superficial fascia are most probably divided, as also a few small arterial branches from the external pudic and superficial epigastric artery; should these bleed smartly, they should be secured with the ligature.

Sponge the surface carefully, and proceed to divide the different layers which cover the hernial sac, viz. Scarpa's fascia, the external spout-like fascia, the sheath of the cremaster muscle, and the fascia propria: this must be done by cautiously scratching an opening in each layer; through this a director is to be introduced upwards and downwards, and the fascia divided.

By these means the hernial sac will be exposed; it is recognized by its bluish transparent appearance. Pinch it up between the fingers, and you thus feel the intestine and omentum within; raise it carefully, and make a small opening into it by holding the knife horizontally: the lower part of the sac should be selected for this purpose, as here the fluid in its interior collects, and thus separates the sac from the hernia; adhesions, too, seldom exist in this situation. Through this aperture introduce the director, keeping it close to the inner surface of the sac, and divide the hernial sac freely in the direction of your first incision. A quantity of water instantly escapes, if intestine be present, and extensive adhesions do not exist. You now proceed to examine the contents of the tumour; these are most probably both omentum and intestine, the former in *front*, the latter *behind*; carefully spread out the omentum, for two reasons: first, that you may ascertain that it is not the cause of the strangulation; second, it will thus protect the intestines from the knife.

Now examine for the stricture: this is best done by introducing the little finger along the front of the omentum towards the inguinal canal; it will be found to exist most frequently either at the lower margin of the internal oblique muscle, at the internal abdominal ring, or in the neck of the sac; it may be also at the external abdominal ring in cases of old hernia.

If the stricture should be at one of the three first-mentioned parts, and that the inguinal canal retains its natural length, it will be necessary to slit up the external ring so as to bring the parts more completely into view; the edges of the wound being separated, draw down the hernial sac, and passing Sir A. Cooper's probe-pointed bistoury upwards, guided by the finger, divide the stricture *upwards* and *outwards*. A small incision will be sufficient for this purpose.

The stricture having been divided, you carefully examine the condition of both omentum and intestine; if they be sound, you return them, the intestine first, by pressing that part first which has descended last, and next the omentum. Assure yourself, by the introduction of the finger, that the parts have been completely returned, and do not still lie in the inguinal canal, as it is possible a second stricture higher up may exist, which will prevent the hernia passing into the abdomen, and render your operation useless. The omentum, if small in quantity, may be left in the mouth of the hernial sac; it will most probably contract adhesions here, and thus prevent the formation of a future hernia. The edges of the wound are now to be closed by adhesive plaster, or one or two points of suture passed through the skin only, a little simple dressing laid on, and the patient returned to bed.

It frequently happens that this treatment of the intestine and omentum is not applicable: thus it may happen that the intestine is mortified, and not in a fit state to be returned. Mortification of the intestine is best ascertained by its breaking beneath the moderate pressure of the fingers; it is also frequently speckled with greenish spots.

Some have asserted that a dark-brown colour, and the loss of the smooth polished appearance of the serous membrane, are sure indications of its gangrenous condition: this is not the case, as the brown colour may be caused by the turgid state of the vessels, and the loss of transparency by the effusion of lymph on the serous surface. We should depend most on the degree of resistance possessed by the intestine when compressed between the fingers.

If it should be grangrenous, the stricture is to be divided, the intestine laid open so as to give exit to its contents and relieve the patient, and the wound covered with an emollient poultice. In favorable cases the sloughs separate, the wound granulates, and an artificial anus is formed, which may be subsequently got rid of by appropriate treatment.

Nor should the practitioner content himself with examining the part of the intestine exposed to view; he should draw it carefully down, and ascertain that the pressure of the stricture has not caused an opening in the constricted part: this may occur even in cases where the rest of the intestine is perfectly sound; under such circumstances, the stricture is to be divided, and the hernia left unreduced.*

If one small aperture should have formed in the intestine, while the remainder is sound, the opening may be secured by raising the part with the forceps, and passing a small ligature round it, the intestine may then be returned.

Adhesions frequently exist between the intestine and hernial sac; these, if recent and not extensive, may be at once broken through; if of longer standing, the knife may be used, taking care to infringe rather on the sac than on the intestine: should they be extensive, the intestine should be allowed to remain. In all cases the use of *force* should be avoided, as the intestine is easily ruptured.

The *omentum*, too, occasionally causes the surgeon some trouble. It also may be adherent to the inner surface of the sac; if so, the adhesions should be freely divided, and it returned. Not unfrequently, if a large portion have descended, its folds unite, so as to form one solid mass: the return of such would be impossible, and, if possible, exceedingly injudicious, as the presence of so large a foreign body (as it may now be considered) in the abdomen would excite peritoneal symptoms. The plan to be adopted is, to remove the mass with the knife, and return the remainder to the mouth of the hernial sac, so as to plug up the opening. After the removal of the portion of the omentum, numerous vessels will bleed; the hemorrhage can be in general restrained by the laceration or torsion of the vessels with the forceps. Should this be found insufficient, the vessels that continue to bleed should be secured by ligature, taking care at the same time not to include any portion of the omentum. On no account should the omentum be returned until hemorrhage is completely restrained, as the warmth of the abdominal cavity will otherwise reproduce the bleeding. The ligatures may be allowed to hang out of the wound; they will separate in three or four days, or they may be cut short; in the latter case they may ultimately either escape through the wound, or make their way into one of the intestines, and thus be discharged per anum.

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* There is no occasion, as recommended by the older surgeons, for stitching the intestine to the edges of the opening, as adhesions almost invariably exist between these parts, which connect them closely together, and prevent the sudden retraction of the intestine into the abdomen.

Sir A. Cooper objects to the use of the knife in destroying the adhesions of the omentum, notwithstanding that he advocates the cutting away the omentum; we know not on what grounds.

The omentum is sometimes gangrenous; this condition of it may be ascertained by the blood being coagulated in the veins, by a peculiar crispy feel it presents, and by its giving way beneath the fingers. No green spots form upon it as on the intestine. The omentum is here to be removed close to the mouth of the hernial sac, and the vessels secured as before.

The old practice of placing a ligature on the omentum, so as to cause its separation, cannot be too highly reprobated; it is a substitution of one species of strangulation for another.

If we are called to operate on a *large hernia*, we should content ourselves with dividing the stricture without opening the hernial sac; should we cut into the sac, a large serous surface is exposed, and most probably peritoneal symptoms will supervene. In these cases we are seldom able to reduce the hernia, from the extensive adhesions that exist; it must be left therefore in situ, and supported, when the patient recovers the operation, in a bag truss. Here the stricture is frequently at the external abdominal ring: in this instance there is little danger of wounding the epigastric artery, no matter what direction we give the knife; unless, indeed, we prolong our incision to a most unwarrantable length.

Inguinal hernia may be *strangulated in the inguinal canal* before it has descended into the scrotum. As the tumour in such instances is much smaller than usual, they embarrass the surgeon not a little, especially if the hernia have only projected through the internal abdominal ring. Our incisions here must be made directly over the tumour, until we arrive at the intestine. The coverings will depend on the part of the inguinal canal in which the hernia is contained.

HERNIA OF THE CÆCUM.

The *cæcum* has been found in an inguinal hernia. As this intestine wants the peritoneum posteriorly, this surface of it contracts adhesions to the scrotum, and cannot be returned.

When operating upon it, the peritoneum which the intestine has brought along with it, and which lies in front and to its inner side, must be cut through before it can be exposed. It is at once known by the appendix vermiformis. It is possible that the posterior surface of the cæcum may present itself first to the surgeon, and thus the intestine be cut into in mistake for one of its coverings; the direction of the muscular fibres may point out the nature of the affection.

HERNIA OF THE BLADDER, OR CYSTIC HERNIA.

When the *bladder* protrudes in a hernia, there is no hernial sac; this viscus merely brings the peritoneum with it, which is related to it as in the natural state. We are not aware that any operation has been found necessary in such cases.

CONGENITAL HERNIA.

This form of hernia is a modification of oblique inguinal hernia: it takes place in consequence of the tunica vaginalis not having been obliterated at its superior part. The hernia thus descends into the cavity of the tunica vaginalis, where it lies in close contact with and beneath the testis. It is evident from this that no distinct hernial sac exists.

In order to explain this more fully, it must be recollected that the testis, at the early periods of fœtal life, is an abdominal viscus. It commences its descent, or more properly speaking ascent, towards the scrotum, at the beginning of the sixth month, makes its way gradually along the inguinal canal, guided by the gubernaculum testis, and finally arrives in the scrotum, shortly before or, it may be, after birth.

From the partial covering which the gland receives from the peritoneum, it carries with it a duplicature of this membrane, which, in after life, is known as the tunica vaginalis.

Immediately after the descent of the testis, the upper part of the tunica vaginalis is closed by the adhesive inflammation, and ultimately degenerates into loose cellular tissue; whilst the lower part forms a distinct sac (the tunica vaginalis), retaining all its original properties. Now it is evident that should an intestine be protruded downwards before this obliteration has taken place, it will descend into the tunica vaginalis, or bag of the peritoneum containing the testis.

Congenital hernia may be distinguished from common inguinal hernia by the greater difficulty of distinguishing the testis in it, in consequence of the tunica vaginalis being thicker than the common hernial sac, the situation of the gland with respect to the hernia, namely, above and behind it; the wasting of the testis from the pressure of the hernia upon it, and by the adhesions which so frequently form between the hernia and the testis; as may be ascertained by attempting to return the former into the abdomen, when the testis will be found to ascend with it.

The operation for the relief of strangulated congenital hernia differs but little from that recommended for the more common species. Sir A. Cooper advises three inches of the tunica vaginalis to be left undivided below, so as that the testis may be covered, and unnecessary irritation avoided. Care must be taken, in opening the sac, that the vessels of the chord, which are frequently spread out on its anterior surface, are not wounded.

INFANTILE OR ENCYSTED HERNIA.

In this form of the disease the hernia is also contained in the tunica vaginalis, but has an immediate covering derived from the lymph that has been poured out by nature, with a view to close the superior portion of the tunica vaginalis.

As we have already stated, immediately after the testis has descended into the scrotum, the process of obliteration commences in the upper part of the tunica vaginalis; a layer of coagulable lymph is thrown out, which adheres to the opposed surfaces of the peritoneum; against this layer of lymph the intestine is protruded. The lymph is sufficiently organized to prevent the intestine making its way through it, yet not strong enough to prevent its descent altogether; consequently the intestine carries with it the lymph, and thus the hernia receives from it an immediate covering or cyst, within the tunica vaginalis.

The operation does not differ from that recommended for congenital hernia. Both these forms of hernia may first present themselves in adult life.

INGUINAL HERNIA IN THE FEMALE

Occurs much less frequently than in the male, owing to the smaller size of the inguinal canal. It descends into the labium, and is in general small. It is almost always reducible. Should it become strangulated, the operation will not differ essentially from that recommended for the male. The lower part of the peritoneal bag, according to Sir A. Cooper, contains only water. The incisions should not be prolonged much into the labium.

DIRECT INGUINAL HERNIA.

From the deficiency in the external oblique tendon, described in oblique inguinal hernia, under the name of the external abdominal ring, it follows that a hernia may be protruded directly forwards from the abdomen through this aperture, without traversing the inguinal canal; this will therefore form the direct inguinal hernia.

Fortunately nature has so protected this opening posteriorly, that this species is comparatively rare. The parts that oppose its formation lie behind the ring; they are the triangular ligament or Colles's fascia, the conjoined tendons, the edge of the rectus muscle, and the transversalis fascia attached to the outer edge of this muscle and to the conjoined tendons.

These barriers are not, however, in all cases sufficient. As a direct inguinal hernia makes its way forwards through the external ring into the scrotum, it pushes before it the peritoneum which forms the hernial sac; it next either bursts through, or carries with it, the transversalis fascia; and then, passing to the outer edge of the rectus muscle and the conjoined tendons, it escapes through the external ring, and is here covered by the external spout-like fascia, the superficial fascia, and the integument. It is evident that the hernia can receive no covering (or at least a very partial one) from the cremaster muscle, nor from the fascia propria of oblique inguinal hernia, as it does not descend through the inguinal canal. Sir A. Cooper states that it receives a covering from the transversalis tendon and fascia. By the former we consider him to mean an expansion from the transversalis fascia, where it is attached to the conjoined tendons. The epigastric artery, too, lies to its outer side; hence we divide the stricture in this form of hernia *upwards* and *inwards*. As the hernia emerges from the external ring, it lies *internal* and a little *posterior* to the spermatic chord.

Direct thus differs essentially from *oblique* inguinal hernia in its *coverings*, and in its *relations* to the *epigastric artery* and *spermatic chord.*

When the hernia has been formed suddenly, we are enabled to distinguish the two forms of inguinal hernia, by the direct course backwards, which the direct species takes, into the abdomen. This, it should be recollected, will not always avail us; as, in old cases of oblique inguinal hernia, the two rings will be in close apposition; and thus a hernia, formed originally by oblique descent, will present the appearance of one by direct descent. As in the former, the epigastric artery is drawn down to the external ring along with the hernial tumour, it still retains its original relation to the neck of the sac, namely, to its internal side; hence, in all doubtful cases, we should divide the stricture *directly upwards*.

If we examine the lower part of the parietes of the abdomen on their inner surface, by raising the intestines from the cavity of the pelvis, leaving the peritoneum in situ, we shall there see two depressions or fossæ on each side, which seem to invite, as it were, to the protrusion of a hernial tumour. Between these, three projecting chords may be noticed; one of these is situated on the mesial line, and is formed by the urachus, which ascends from the superior fundus of the bladder to the umbilicus; the remaining two are situated one on each side. They are formed by the degenerated umbilical arteries, which ascend from the lateral surfaces of the bladder, converging, to the umbilicus.

These depressions are named the *internal* and *external inguinal fossæ* or *pouches*. The *internal inguinal fossa* lies between the urachus and the degenerated umbilical artery, the first of which separates it from its fellow of the opposite side. It is triangular in shape, the base inferiorly being formed by the crest of the pubes. It lies opposite to the *external ring*, and thus leads to the formation of *direct inguinal hernia*.

The *external inguinal fossa* lies to the outer side of the umbilical artery; it lies superior and external to the other, and is somewhat larger; it leads to the *internal ring*, and consequently to the formation of an *oblique inguinal hernia*.

FEMORAL HERNIA.

This form of hernia is more frequent in the female than in the male, in consequence of the greater breadth of the pelvis in the former. Although less frequently met with than inguinal hernia, it is perhaps more the subject of operation, as it is more liable to strangulation from the smallness of the aperture through which it escapes from the abdomen, and the resistance of the structures which form the circumference of the opening.

Femoral or, as it is sometimes named, crural hernia is so called from its making its appearance, when first noticed, in the thigh; in the upper, inner, and anterior part of which region it descends, beneath Poupart's ligament, to the inner side of the femoral vessels.

To expose the anatomy of femoral hernia, raise the integuments from the anterior surface of the upper third of the thigh.

On doing so, we bring into view the *superficial fascia.* This is the common subcutaneous cellular tissue met with in every part of the body beneath the integuments: it is here well marked, and is frequently loaded with fat. On all sides it is continuous with the surrounding cellular tissue. Externally a few transverse fibres may be occasionally met with in it. It forms the most superficial covering of a femoral hernia.

In the superficial fascia we notice several arteries, veins, nerves, and lymphatic glands. The *arteries* are branches of the external circumflexa ilii, external pudic and superficial epigastric arteries: they arise from the femoral artery a little below Poupart's ligament, perforate the cribriform fascia, and are lost in the superficial fascia and integuments. The external circumflexa ilii branches pass outwards behind the ilium; the external pudic to the organs of generation; whilst the superficial epigastric ascends inwards over Poupart's ligament, to be lost in the parietes of the abdomen. The external pudic and superficial epigastric are frequently wounded in the operation for strangulated femoral hernia, and may require the ligature.

The *veins* are branches from the surrounding integuments, and the *great* or *internal saphena* vein. This large vein commences at the inner side of the foot and leg, ascends along the internal surface of the thigh, curves outwards at its upper part, and, at about an inch and a half distance from Poupart's ligament, perforates the cribriform fascia, through the saphenic opening, to join the femoral vein.

In some cases a second large vein ascends along the anterior surface of the thigh, which either terminates in the saphena or in the femoral vein. In operating for strangulated femoral hernia, as well as in other operations in this region, the saphena vein is much exposed. It may be avoided by not prolonging our incisions too much inwards. Not unfrequently it becomes varicose, and may be mistaken for a femoral hernia.

The *nerves* met with in the superficial fascia are small branches derived principally from the anterior crural.

The *lymphatic glands* compose the inferior set of inguinal glands. They are arranged in the vertical direction, and consist of two sets, a *superficial* and *deep*. The *superficial* are three or four in number, and are inclosed in a capsule of the superficial fascia. The *deep* are two or three in number: they accompany the femoral vessels; one is almost constantly lodged in the femoral ring.

Enlargement of these may be mistaken for a femoral hernia, and, from their relation to the femoral artery, for an aneurism of this vessel.

Dissect off the superficial fascia. This may be accomplished with ease, until we arrive opposite the *cribriform fascia;* here the two are so intimately connected, that it is impossible to separate them without injury to one or the other.

On completing the dissection, the *fascia lata* is brought into view. This is a dense layer of fibrous structure, which invests the muscles of the thigh. *Inferiorly*, it is attached to the tendons and ligaments about the knee-joint; from this it ascends, forming sheaths for the different muscles, and sending in processes between them. Having arrived at the upper and anterior part of the thigh (where it is connected with the anatomy of femoral hernia), it divides into three portions, the *iliac*, *pectineal*, and *cribriform fascia.*

The *iliac* (so called from its connexion with the os ilii), or *external* portion of the fascia lata, is the strongest: posteriorly it is attached to the crest of the ilium; in front we find it closely attached to the lower margin of Poupart's ligament. As we trace it inwards towards the pubes, it terminates in an elongated process, which passes in front of the femoral vessels, gets to their inner side, and is implanted into the front of the pectineal portion of the fascia lata. Some of its fibres are here reflexed behind Poupart's ligament, they become continuous with the base of Gimbernat's ligament, and are inserted with it into the ilio-pectineal line. The *superior edge* of this prolonged portion of the fascia lata is attached to Poupart's ligament; its *inferior* margin is free and concave, the concavity looking downwards and inwards: this portion of it is named Hey's ligament, or the *falciform process* of the fascia lata.

A short distance below Hey's ligament, the iliac portion of the fascia lata is gradually prolonged into the cribriform fascia, but not unfrequently presents, in the dissected state, a well-defined edge at the outer side of the femoral artery. Still more *inferiorly*, the iliac portion of the fascia lata becomes continuous with the pectineal portion in front of the femoral vessels; they here, conjoined, form a well-defined semilunar margin, the concavity of which is turned upwards, and forms *Burns's ligament*. This margin of the fascia lata, on a careful examination, will be found to be reflexed backwards on the anterior surface of the femoral vessels, and so intimately united with the sheath, as to prevent altogether the descent of a hernia beneath it.

The *pectineal* or *pubic* or *internal* portion of the fascia lata lies in front of the pectineus muscle. *Internally*, it is attached to the symphysis pubis, where it covers the gracilis and adductor muscles; as we trace it outwards it passes in front of the pectineus muscle, gets behind the femoral vessels, at the outer edge of which it meets with the tendons of the psoas magnus and iliacus internus muscles; it here divides into two laminæ, one of which passes forwards, to be attached to the posterior surface of the external or iliac portion of the fascia lata, whilst the other passes backwards to be attached to the capsular ligament of the hip-joint.

Superiorly, the pectineal fascia ascends in front of the pectineus muscle, to be inserted into the ilio-pectineal line, where it becomes continuous with the fascia iliaca, and with Gimbernat's ligament. *Inferiorly*, it becomes continuous with the iliac portion of the fascia lata, to form Burns's ligament.

Femoral hernia, as it descends, rests on the pectineal fascia. Between these two portions of the fascia lata, and immediately in front of the femoral vessels, an oval-shaped space exists, which is covered over by a thin layer of cellular substance, named the *cribriform fascia* or *middle* portion of the fascia lata. This is in general described as a process of the fascia lata, with which indeed it is perfectly continuous at the circumference of the opening; at the same time it is so intimately connected to the superficial fascia, being in fact identified with it, that it may be with equal propriety described as being derived from this fascia.

The cribriform fascia is perforated, as its name implies, by a number of foramina, which transmit numerous veins and nerves, passing between the superficial and deeper parts. One, larger than the rest, is formed by the saphena vein dipping in to join the femoral; this is the saphenic opening; through it a femoral hernia most frequently passes forwards beneath the superficial fascia: it is bounded inferiorly by Burns's ligament. From the little resistance the cribriform fascia affords, a femoral hernia soon makes its way through it; this it effects either by bursting through the fascia, or dilating one of the openings in it, most frequently the saphenic.

Having thus examined the parts on the anterior surface of the thigh, we next proceed to ascertain by what means a hernia is enabled to escape from the cavity of the abdomen, so as to descend behind the fascia lata. For this purpose we draw the peritoneum and viscera out of the iliac fossæ, and examine the parts which descend beneath Poupart's ligament. As this ligament stretches across the brim of the pelvis, between the anterior superior spinous process of the ilium and the tubercle of the pubes, it leaves a large space (the crural arch) between it and the bone, by means of which several structures are transmitted from the pelvis to the thigh, or in the opposite direction. Thus, between the spines of the ilium, the inguino-cutaneous nerve descends; internal to this, the psoas magnus and iliacus internus muscles, and between them the anterior crural nerve, descend in a deep fossa; still more internally the femoral vessels pass. On the inner side of these the absorbent vessels, from the lower extremity ascend through a well-marked opening (the femoral ring).

So many parts thus passing beneath Poupart's ligament, nearly obliterate the space between it and the bone, so that the descent of a femoral hernia is, by these means, at least partially prevented. As, however, many interstices must exist between these parts, it becomes necessary that some additional structure should exist, in order to preserve the integrity of the abdominal cavity. This structure does exist, and is formed by the junction of the transversalis fascia and the fascia iliaca behind Poupart's ligament.

The *fascia transversalis* descends from the inguinal canal, passes backwards, and, behind Poupart's ligament, meets with the *fascia iliaca.*

This is a dense layer of fascia, which invests the anterior surface of the iliacus internus muscle; *externally* and *superiorly*, it is firmly attached to the inner lip of the crest of the ilium. Tracing it *inwards*, it covers the muscle, passes behind the external iliac vessels, sending off at the same time an expansion, which passes in front of these vessels, binds them down, and forms the fascia propria of the external iliac artery, first described by Mr. Abernethy. At the inner side of the iliac vessels the fascia iliaca becomes attached to the ilio-pectineal line, whence it descends into the pelvis, under the name of the pelvic fascia. Near the pubes the fascia iliaca becomes continuous with the pectineal portion of the fascia lata, and Gimbernat's ligament. *Inferiorly*, or towards the femoral region, the fascia iliaca curves forwards, and meets the transversalis fascia immediately behind Poupart's ligament, where the two fasciæ, united, form a dense whitish tendinous line, which, indicating the course of the internal circumflexa ilii vessels, extends from the spine o the ilium to the outer edge of the femoral artery, and thu precludes the possibility of a hernial tumour descending between these points.

At the *outer* side of the femoral artery the fascia transversalis and the fascia iliaca separate; the fascia transversalis descends into the thigh in front of the femoral vessels, whilst the fascia iliaca descends behind them, thus inclosing these vessels in a distinct well-marked sheath. This—the sheath of the femoral vessels, of a funnel-shape, with the base superiorly, the apex inferiorly—is gradually lost in the cellular coverings of the femoral vessels in the thigh.

The femoral artery and vein are not in close contact whilst contained in the sheath, but are separated by a septum or partition, which passes from its anterior to its posterior wall; and which, thus opposing the separation of these walls, prevents the descent of a hernia between the femoral vessels and the fascia transversalis, or anterior wall of the femoral sheath. In addition to this, the fascia transversalis is connected by cellular tissue to the cellular covering of the vessels, so as to assist materially in preventing the descent of a hernia in this direction.

On the *inner* side of the femoral vessels, we have just stated that a large aperture exists for the transmission of the absorbent vessels from the lower extremity. Here the provisions against the descent of a hernial tumour are but trifling, and here therefore it is that a femoral hernia first makes its way from the cavity of the abdomen. This opening is named the *femoral ring*, and should be attentively studied. It is as yet concealed from view by a delicate layer of cellular tissue, which may be described as the termination of the fascia transversalis, on the inner side of the femoral vessels. This forms the *fascia propria* of femoral hernia, inasmuch as a hernial sac, protruding through the femoral ring, carries the fascia before it, and thus receives from it an immediate investment, or a fascia propria. Although in the natural state the fascia propria is thin and delicate, yet in old cases of hernia it becomes thickened and condensed, so as to present a membranous appearance. In some cases it may be burst through, so that no fascia propria will then exist. Mr. Guthrie has recorded an instance of this.

On removing the fascia propria, the *femoral ring* will be at once exposed. It is triangular in shape, the *base* externally at the femoral vein, the *apex* internally at Gimbernat's ligament: it is bounded in *front* by Poupart's ligament and the reflexed portion of the falciform process of the fascia lata; *behind*, by the horizontal ramus of the pubes, covered by the pectineus muscle and the pectineal fascia. The spermatic chord, or ligamentum teres, lies a little above and in front of it, and the epigastric artery curves to its outer side. In it, we frequently meet with a lymphatic gland.

Here, then, is the unprotected part of the abdomen, through which a femoral hernia descends into the thigh. As the hernia escapes through the ring, it pushes before it the peritoneum, which forms the hernial sac, as also the fascia propria, which, together with the lymphatic gland in the ring, affords but a feeble resistance; the latter is soon pushed aside, the former becomes one of the coverings of the hernia, which, descending into the thigh beneath Poupart's ligament, rests on the pectineal fascia, behind the falciform process of the fascia lata. It soon arrives opposite the cribriform fascia. Its further descent is prevented by the convexity of the saphena vein, by the attachment of Burns's ligament to the front of the femoral vessels, and by the motions of the thigh on the pelvis. Meeting with little resistance from the cribriform fascia, it changes its course, turns *forwards*, bursting through the fascia, or dilating one of the apertures in it, most frequently the saphenic opening, and lies beneath the superficial fascia. It soon changes its course a second time; it now turns *upwards*, ascends over Poupart's ligament, and finally rests, above this ligament, on Scarpa's fascia of inguinal hernia, which alone separates it from the tendon of the external oblique muscle. It is here then covered by the *integument, superficial fascia, fascia propria*, and *hernial sac.*

Sir A. Cooper states that a femoral hernia descends in the crural sheath, or sheath of the femoral vessels. This is a point of dispute that can alone be settled when the extent of the crural sheath is decided. Most assuredly it does not descend in that part of the sheath which contains the femoral vessels (and which should be alone called the crural sheath), as a distinct septum always exists between the hernia and the femoral vein.

We have stated that the femoral ring is bounded internally by *Gimbernat's ligament.* This is the third insertion of Poupart's ligament, from the pubic extremity of which it extends obliquely inwards and backwards, to be inserted into the ileo-pectineal line: it is triangular in shape, the apex turned inwards towards the pubes; its base, directed outwards, is semilunar, and forms the inner boundary of the femoral ring; one edge is turned forwards, and is attached to Poupart's ligament; the other is directed backwards and inwards, and is implanted into the ileo-pectineal line. Gimbernat's ligament is of use in preventing the descent of a femoral hernia on the inner side of the femoral ring. It is by many considered to be the seat of stricture in strangulated femoral hernia.

The femoral ring possesses in many subjects a relation which should not be overlooked; viz. to the *obturator artery*. This vessel in general arises from the internal iliac artery. Where this is the case, it can have no relation to a femoral hernia; but in numerous instances it will be found to arise from the internal epigastric, close to the origin of this vessel from the external iliac artery.

Now, as its ultimate distribution is to the parts in the neighbourhood of the obturator foramen, it necessarily follows, when such is its origin, that, in order to arrive at this foramen, it must cross the femoral ring, and consequently a femoral hernia, if such should exist. As it proceeds to the foramen, it may either pass *directly* to it along the *outer* side of the neck of the hernia; or it may first pass along its *posterior* surface, and then enter the foramen; or it may wind along the *anterior* surface of the neck of the sac, and then descend to its *inner* side. Fortunately this last course is the least frequent of the three, (occurring, according to Mr. Lawrence, but once in a hundred operations,) as when the artery is so related to a femoral hernia, it is exceedingly difficult to avoid it, should we be called on to operate, particularly if the operator should prefer the division of Gimbernat's ligament for the relief of the stricture.

There is no point perhaps connected with femoral hernia respecting which surgeons are more at variance than as to what forms the stricture in this disease when strangulated. We have Gimbernat, Hey, and Burns, each contending that his ligament is the offender, so that the practitioner is left completely in doubt as to the true seat of constriction. Sir A. Cooper asserts that the stricture is seated in the "crural arch," and recommends the incision for its division to be directed upwards and inwards, thus dividing a part of the crural arch or Poupart's ligament.

OPERATION FOR STRANGULATED FEMORAL HERNIA.

The remedies for the relief of strangulated femoral hernia do not differ from those made use of in inguinal or any other species of hernia; they are, the taxis, bleeding, tobacco enema, the warm bath, cold applications, &c. It is necessary, however, that these remedies should be had recourse to without delay, as this form of hernia, when strangulated, more rapidly hastens to a fatal termination than any other. Sir A. Cooper has met with one case in which death took place in seventeen hours after the commencement of the strangulation, and other writers record similar instances.

When making use of the taxis, two circumstances are to be particularly attended to, namely, the position of the patient, and the direction in which we press the tumour.

The patient should be placed in the semi-recumbent posture, and the thigh flexed on the abdomen and rotated *inwards;* thus Poupart's ligament will be completely relaxed, so as to facilitate considerably the reduction of the hernia.

The next thing to be attended to is the direction which the hernia has taken from the abdomen. We should recollect that, as it rests on the external oblique muscle above Poupart's ligament, the fundus of the hernia lies directly in front of its neck; we should therefore first draw the tumour *downwards* until we have brought it opposite the cribriform fascia, then press it *backwards* through this, and then *upwards* through the femoral ring.

Should we, forgetting the course of the hernia, press it at first either backwards or upwards, our efforts will be ineffectual and highly injurious, if not fatal, to the patient, as it is possible that the intestine may be ruptured by such violence.

It cannot be too firmly impressed on the mind of the practitioner that many diseases may be confounded with a femoral hernia, and that a correct diagnosis should be made before proceeding to the operation. Thus, for instance,

A *varicose state of the saphena and femoral veins*, near to Poupart's ligament, has been confounded with a femoral hernia. We can easily distinguish between them in the following manner. Place the patient in the recumbent posture, reduce the tumour, make pressure on the femoral ring; if it be a hernia, the tumour will not reappear; if it be a varicose state of the vein, the pressure will rather increase it. Again, if the pressure be applied *beneath*, the tumour will reappear on the patient's standing up if it be a hernia, but not so if it be a varicose state of the veins.

Enlargement of the inferior set of inguinal glands may be confounded with a femoral hernia. In some cases we can recognize the glands by their circumscribed shape; the absence of any neck to the tumour leading into the femoral ring, and their greater solidity; in others, on the contrary, it is impossible to ascertain the true nature of the disease in consequence of the small size of the tumour, the fat condition of the patient, and the thickened state of the absorbents which pass through the femoral ring and resemble the neck of the sac. In such cases, should the symptoms of strangulation continue unrelieved, the surgeon is justified in cutting down on the tumour to ascertain its nature. We have known eminent surgeons to cut down on an enlarged gland in mistake for a femoral hernia. It should be borne in mind too that a hernia may be concealed behind an enlarged gland, which will add much to the difficulty of the diagnosis.

Psoas abscess pointing beneath Poupart's ligament may be mistaken for a femoral hernia. The two diseases have many symptoms in common, viz. the situation of the tumour, the impulse on coughing, their disappearance on the patient's assuming the recumbent posture. They may be distinguished, whilst the patient is in this position, by relaxing the abdominal muscles, and alternately pressing with each hand on the iliac and femoral regions, when, if the disease be an abscess, the fluctuation of the matter will at once point it out.

An *inguinal hernia* too may be confounded with a femoral; we distinguish between them by the relation of Poupart's ligament to them. In inguinal hernia, if we draw up the tumour, Poupart's ligament may be in general distinctly traced with the fingers from the ilium to the pubes; but, on the contrary if we draw it downwards on the thigh, the hernia is felt crossing the ligament. If the disease be femoral, the elevation of the tumour will cause it to cross Poupart's ligament; its depression will leave the ligament free.

Having satisfied ourselves that the disease is strangulated femoral hernia, and that the operation is indispensable, we proceed to its performance.

Place the patient in the horizontal posture on a table of convenient height, with his legs hanging over its edge, and his shoulders a little elevated. Make the first incision along the tumour, in a nearly transverse direction, about half an inch below Poupart's ligament,* from the centre of this carry your second incision about two inches and a half in length upwards toward the umbilicus, you will thus have made a wound of an inverted T shape (⊥), dividing the integument, and bringing into view the superficial fascia. In this the external pudic and superficial epigastric arteries may be divided; if the hemorrhage be troublesome, they should be secured with the ligature. Take care to avoid the saphena vein, which lies a short distance beneath your transverse incision.

Next proceed to divide the coverings of the hernial tumour, viz. superficial fascia, fascia propria, and hernial sac, in the cautious manner recommended when speaking of inguinal hernia.

The contents of the sac having been exposed, you proceed to ascertain with the little finger the seat of stricture; this is at the femoral ring, but at what part? This is a question extremely difficult to decide upon. Sir A. Cooper directs us to cut upwards, forwards, and inwards, taking care to draw the spermatic chord out of the way if we operate on the male subject. Mr. Colles advises the division of the "pectineal attachment of the fascia lata." Gimbernat advocates the division of the base of the third insertion of Poupart's ligament, and this we may say is the operation preferred at the present day.

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* Sir A. Cooper recommends the incision to be made along Poupart's ligament.

It is accomplished by drawing the intestine outwards, and introducing the probe-pointed bistoury on a director (if that can be accomplished, if not on the finger,) and then cutting directly inwards through the base of Gimbernat's ligament. The stricture being divided, the hernia is to be returned, which may be accomplished without difficulty if no stricture exist in the neck of the sac. If this should be the case, it must be divided, and thus the hernia reduced.

The principal objection to this method of operating arises from the risk of wounding in its performance the obturator artery, when it arises from the epigastric, and crosses the front and inner side of the hernial sac. This variety in the course of the artery is so very rare as to constitute no solid objection to the practice; indeed the artery may be avoided even when it takes this course, by making use of a bistoury resembling Sir A. Cooper's blunt-pointed bistoury, but differing from it in having a cutting edge of only three or four lines in extent. By this means the ligament can alone be cut; a very slight incision being sufficient for our purpose. The cutting of the ligament is at once ascertained by the operator by the peculiar feel it communicates to his hand.

The plan recommended by Sir A. Cooper, of cutting the stricture upwards, forwards, and inwards, exposes the spermatic chord, and consequently the spermatic artery, to injury in the male subject. By dividing Poupart's ligament, it also weakens the lower part of the abdomen. It is true that the vast experience of this eminent surgeon gives to any recommendation from him an authority which should be opposed with diffidence; yet we must recollect that this very experience enabled him to perform operations with safety, that might in less skilful hands be attended with considerable difficulty and danger. Hence surgeons prefer the operation recommended by Gimbernat; and this, there can be no question if properly performed, will be sufficient, as by it we *enlarge the femoral ring*, which is all that is requisite to the reduction of the hernia.

On no account should we cut upwards and *outwards*, as the epigastric artery and femoral vein lie in this direction.

It has been proposed of late years to divide the stricture external to the hernial sac, and then to return the whole into the abdomen. Such a proceeding is impossible, as the sac contracts adhesions immediately after its descent to the surrounding parts; and even were it possible, it is highly objectionable, as it frequently occurs that the stricture is situated in the neck of the sac, or it may be in its interior, and thus the hernia will be returned without the strangulation having been removed.

UMBILICAL HERNIA, OR EXOMPHALOS.

This species of hernia is but rarely seen in the adult; it is, however, of frequent occurrence in children immediately after birth, in consequence of the cries of the child, and the open state of the umbilicus. It then protrudes through this aperture in the umbilical chord to the distance of an inch or more, and may be distinctly recognized through its coverings.

The disease, in adults termed umbilical hernia, is in the great majority of cases a ventral hernia, as it protrudes not through the umbilicus but above it, through the linea alba, which here, from the divergence of the recti muscles, presents a less degree of resistance than beneath the umbilicus. In corroboration of this statement the umbilicus, in almost all cases of umbilical hernia in adults, may be seen on one or other of the surfaces of the tumour, which is not the case in the true umbilical hernia.

Occasionally umbilical hernia may present itself in the adult, but this occurs only in cases where, from the protrusion of a hernia in infancy, or from other causes, the umbilical opening has lost that tendency to contract which it possesses after birth; once closed, this opening becomes the least yielding portion of the abdominal parietes.

The anatomy of umbilical hernia is simple. It is covered by the integuments, superficial fascia, and peritoneum. The peritoneum, and sometimes the superficial fascia, become absorbed, so that the coverings of the hernia are exceedingly thin. Much care then will be required on the part of the surgeon when operating, not to wound the intestine. Some have altogether denied the existence of a hernial sac in this form of hernia, but there can be no doubt of its existence, at least for a short time after the formation of the disease.

When reducible, it should be at once returned, and retained in the abdomen by "means of one half of an ivory ball," or a piece of cork cut in this shape, "applied to the umbilicus, and over this adhesive plaster and a belt, which should be supported by straps round the lower part of the belly."

When umbilical hernia becomes strangulated, the usual remedies for the relief of strangulated hernia should be resorted to. Of these the tobacco enema is the most effectual, and should never be omitted, as it has a greater effect in relaxing the muscles, and taking away the cause of stricture, in this than in any other kind of hernia.

Should these remedies fail, the stricture must be divided; for this purpose an incision of an inverted T shape (⊥) is to be made over the tumour, the integument dissected off, and the hernial coverings carefully divided. The sac (if it exist) having been opened, the stricture is to be divided at the superior edge of the opening, in a direction upwards and a little to the left side, in order that we may avoid the umbilical vein, which lies to the right side, and the hernia be returned. The after treatment is the same as that in use for other herniæ. Some surgeons advocate the division of the stricture, and the reduction of the hernia, without opening the hernial sac.

VENTRAL HERNIA.

This form of hernia may occur in any region of the abdomen, but most frequently appears in the linea alba, between the recti muscles, immediately above the umbilicus. It may also protrude through the lineæ semilunares, or in the openings to be observed in the aponeurosis of the external oblique tendon. These apertures in the natural state give transmission to small pedicles of fat, which increasing in size may be mistaken for a hernial tumour. Should they afterwards become absorbed, it is possible that the hernia may protrude through one of the dilated openings, and so occupy the place of the fatty tumour.

From the proximity of hernial tumours to the umbilicus, when they occur in the linea alba, they are frequently confounded in the adult subject with umbilical hernia. They may be in general distinguished by the oval shape of the neck and body of the ventral tumour; these being spherical in the umbilical; and also by the presence of the umbilical cicatrix on one side of the former. The treatment of these tumours is similar to that recommended for umbilical hernia.

Some other varieties of hernia are detailed in more voluminous works, but are extremely rare, and some of them are not recognizable during life, and, if so, not curable by medical art. These anomalous species are obturator, sciatic, perineal, and pudendal herniæ.

REDUCIBLE HERNIA.

There is no period of life wholly exempt from hernia; it may occur in the infant, the adult, or the aged; it is, however, much more frequent at the first and last periods than at the second.

Several circumstances conspire to render hernia, especially the inguinal species, of frequent occurrence in the infant. Thus the open state of the inguinal or spermatic canal, which has just transmitted the testicle into the scrotum, the want of adhesion in the upper part of the tunica vaginalis, and the trifling degree of obliquity in the canal, which is at this period of very short extent indeed, favour the descent of a hernial tumour. In addition to these may be enumerated the want of development of the pelvic cavity, which as yet is not sufficiently capacious to receive the small intestines, which thus are lodged in the abdomen, and are therefore the more directly under the influence of the abdominal muscles and diaphragm so frequently called into exercise in the infant. At this period of life, too, the pelvis descends almost vertically from the spinal column, so that its superior opening looks almost directly forwards. Thus the viscera want the support of the brim of the pelvis inferiorly, and are protruded against the abdominal parietes, which frequently give way.

In the adult this combination of circumstances no longer exists: the spermatic canal becomes elongated, by the spreading outwards of the crests of the ilia; the tunica vaginalis is closed superiorly; the pelvis has become sufficiently developed for the reception of the intestines, and its anterior brim, from its great increase in size, and the peculiar rotation which the pelvis is known to undergo as the individual advances to maturity, receives the impulse communicated to the intestines from above by the diaphragm and abdominal muscles. Here too the parietes of the abdomen possess that degree of strength and integrity which is wanting in either the infant or old subject.

If the adult be by nature so perfectly protected from the occurrence of a hernia, he is more likely to indulge in violent exertions, which frequently produce the disease, than the youthful or aged; he is more exposed to accidents: and thus herniæ are occasionally met with in the otherwise healthy adult. On attentively considering these circumstances, it becomes evident that a hernia in the middle aged is more likely to be produced by violence than by a gradual yielding of the abdominal parietes, and therefore will be much more in danger of strangulation. The female adult has an additional cause for the formation of a hernial tumour in the occasionally impregnated uterus, which forces the intestines upwards out of the pelvis, encroaching itself on the abdominal cavity, and by its progressive distension produces a yielding of the parietes of the abdomen, which is too favorable to the future occurrence of hernia.

In the old subject (second childhood) the predisposition to the formation of hernia becomes reestablished, but from other causes. At this period of life corpulency too often exists, the omentum becomes loaded with fat, and the intestines are thus forced by the intruder from their natural retreat to seek an asylum in the scrotum or elsewhere. Now, also, the abdominal parietes begin to yield, the abdominal rings give way to the frequent impulse of the viscera forced against them by the contraction of the surrounding muscles, so often excited by the many diseases of the thoracic and pelvic viscera to which age is subject.

But, as human nature is subject to few griefs without some compensating joys, the dilatation of the rings so produced renders hernia, at this period of life, not only much less likely to become strangulated, but also less acute in its symptoms when constricted.

Other causes of hernia, besides those mentioned, occasionally exist: these are, a congenital weakness or malformation, the growth of tumours in the abdomen, and wounds of the abdominal parietes.

Hernia, it has been remarked, is more frequently met with on the right than on the left side; this may be accounted for by the greater use that is made of the right side of the body, and also by the oblique descent of the diaphragm from left to right, caused by the presence of the liver in the right hypochondriac region.

THE TREATMENT OF REDUCIBLE HERNIA

Consists in removing the causes, if possible; and where this cannot be effected, to keep the viscera in situ by the application of a truss, or by other means.

The general symptoms of a reducible hernia are an indolent tumour in some of the regions of the abdomen mentioned, the absence of any discoloration of the integuments, the appearance of the tumour in the erect, its disappearance in the recumbent posture, the impulse communicated to it by coughing, and its increase in size at the same time, its diminution when compressed, and occasionally some colicky pains in the abdomen.

When the tumour is composed of intestine only, it may be distinguished from an omental hernia by the irregular unequal doughy feel of the latter, as also by its greater indolence and compressibility. If in the scrotum the omental hernia is more oblong and less round than the intestinal, its weight is also greater.

When the disease is an entero-epiplocele, that is, composed of both intestine and omentum, the diagnosis is more obscure. Indeed, in most cases, the best experienced surgeons find it exceedingly difficult, if not impossible, to distinguish the contents of a hernial tumour, nor is it a matter of any great importance, as equally acute symptoms may be induced by an omental as by an intestinal hernia. The return of an intestinal hernia is frequently, but not always, attended with a peculiar gurgling noise.

When the hernia is reducible, it should be at once returned into the abdomen, and retained there by means of a truss. The manipulation necessary for its reduction is termed the taxis. In all attempts at reduction, the patient should be placed in such a position as will most effectually relax the parts through which the hernia has descended, and this then returned gradually, that is, the portion of intestine that has last descended should be first returned, kept so by means of gentle pressure on the part, and so on until the whole tumour disappears; when reduced, the pad of the truss should be applied over the opening through which *the intestine has escaped from the abdomen.* For example, in oblique inguinal hernia, it should be placed on the internal and not on the external ring. If placed over the external ring, the hernia will be still contained in the inguinal canal, where it is extremely liable to become strangulated, and the pad of the truss, when applied here, may injure the spermatic chord.

By a perseverance in the constant use of the truss, we have reason to expect a perfect cure of the disease from the pressure causing an obliteration of the hernial sac, and the contraction which takes place in the internal ring; thus, the viscera are prevented from descending through it. In the young subject, as just explained, other circumstances assist in the removal of the disease. When the truss has been worn for some time, there is still greater danger of a strangulation ensuing, should it be laid aside and the hernia descend, than previous to its first adoption: this arises from the partially contracted state of the opening, and the thickened state of the peritoneum, induced by the pressure of the pad. Hernia can in general be easily reduced in infants, as the inguinal canal is short, and possesses but little obliquity; it is seldom strangulated, yet Mr. Pott states he has seen an infant of a year old die of a strangulated hernia.

In *congenital hernia*, where the testis has not as yet descended, Sir A. Cooper recommends the truss not to be applied until after the testis has descended into the scrotum.

It frequently happens that, from a thickened state of the omentum or mesentery, from adhesions to the hernial sac, or from other causes, a hernia cannot be returned; it then becomes an

IRREDUCIBLE HERNIA.

There are three states or conditions in which an irreducible hernial tumour may be found; thus it may be either *simply irreducible*, *incarcerated*, or *strangulated.*

Simply irreducible Hernia is that form of the disease which, although it cannot be reduced, is not attended with any serious symptoms.

The patient should in this case wear a bag-truss, which will have the effect of supporting the tumour, and opposing the protrusion of any more of the viscera. Where the hernia is composed of omentum only, moderate pressure may be tried, as it has been found to cause an absorption of the protruded omentum and the gradual return of the hernial sac into the abdomen.

It is evident that great care will be required in the use of the pressure, as otherwise it might be applied where an intestine forms part of the tumour, or it may bring on an inflammation of the omentum, and thus induce general peritonitis. In some cases where the hernia is large and of long standing, the abdominal cavity has become contracted, or a deposit of fat has taken place in its interior, which will materially oppose the reduction of the hernial tumour. Here, if our patient be very anxious to get rid of the disease, the moderate use of opening medicines, bloodletting, and a strict regimen, may give rise to an absorption of the adipose matter, so as to produce a diminution in the size of the hernial tumour, and afford room in the abdomen for its return, which will contribute much to the facility of the reduction of the hernia. Mr. Hey has several times succeeded in this way.

Sir A. Cooper recommends the repeated application of cold to the tumour, which he has found beneficial, by causing a diminution in its bulk, thus conducing to its final reduction.

INCARCERATED HERNIA.

In this form of the disease the hernial tumour is so constricted as to interfere, to a moderate extent, with the functions of the intestines.

It rarely occurs, except in cases of old irreducible hernia, and is most frequently produced by a collection of feculent matter, or of air in the cavity of the intestines. It may be also caused by an increased deposit of fatty matter in the protruded omentum pressing on the intestines, or from an additional portion of intestine or omentum having been forced into the hernial sac.

Incarceration is a condition of the hernial tumour which requires immediate attention, as, if allowed to continue in this state for any length of time, more acute symptoms will at last supervene, and thus the patient will be obliged to submit to an operation for its removal. Nor can we expect otherwise. The constriction of the intestine produces inflammation of the parts protruded; they become swollen, and thus increase the constriction; the inflammation spreads to the interior of the abdomen, and all the symptoms of strangulated hernia set in.

The *treatment* of this form of hernia consists in the judicious use of opening medicine, the administration of enemata, and the use of warm or cold applications to the tumour. The former of these act by relaxing the tension of the parts, the latter by condensing the air in the interior of the intestine. More active remedies can seldom be resorted to, as the patient is in general advanced in life. Nor indeed are the symptoms sufficiently acute to demand or to be benefited by bleeding or other violent remedies.

STRANGULATED HERNIA.

A hernia is said to become *strangulated*, when it is not only irreducible, but when it is so much constricted, that the circulation in the intestine or omentum is either impeded or wholly prevented. Sir A. Cooper asserts that some portion of blood is still capable of being carried to the part by the arteries, but it cannot be returned by the veins.

The *symptoms* of a strangulated hernia commence with a sense of pain about the region of the diaphragm, as if a cord were bound tightly round the upper part of the stomach. This is soon followed by eructation of air from the stomach and intestines. The patient is next troubled with vomiting. At first the contents of the stomach are evacuated, afterwards dark greenish bile; and, finally, if the stricture be on the large intestine, fæcal matter, which constitutes stercoraceous vomiting.

Soon after the commencement of the strangulation the abdomen becomes distended with air collected in the cavity of the intestines, but is not painful; the pulse is hard, frequent, and incompressible. As the disease advances, colicky pains appear throughout the abdomen. These are at first transient, but soon increase in strength and frequency until they are at length followed by a fixed pain. There is generally obstinate constipation, but fæces may be voided in small quantity when the omentum only is strangulated.

The *abdomen* now becomes not only tense, but tender to the touch; the patient lies on his back with his limbs drawn up, and his head supported, that he may relax the abdominal muscles; the bowels are still constipated, the vomiting and eructation continue; the pulse becomes hard, frequent, and *wiry*, and the patient is covered with a cold perspiration. The *tumour* now becomes very tense and hard, in general a little inflamed on the surface of the skin, and tender to the touch.

In this stage the most active treatment becomes necessary. The warm bath, heated from 95 to 100 degrees, bleeding ad deliquium, purgatives, emollient enemata, opiates, cold applications to the tumour, and the tobacco enema, should be had recourse to, if the case will admit of sufficient delay for their adoption.

In the selection of these various remedies, the practitioner must be guided by the peculiarities of the case, as treatment which will be of much benefit in one may be fatal to another. Thus, if the patient be young and plethoric, and the strangulation acute, bleeding, and the warm bath, used for ten or fifteen minutes, so as to induce fainting, will be of much service in relaxing the tension of the parts, and in controlling the peritoneal inflammation; whereas in the old subject and in chronic strangulation, their adoption may sink the vital powers, and lead to a fatal termination. So is it with the tobacco enema.

The use of purgatives is condemned by some, on the grounds that they will not rest on the stomach, and rather increase the irritability of this organ, yet they will be found useful in the chronic strangulation. Opiates are not often resorted to. The best form of cold application to the tumour is pounded ice contained in bladders, or, when this cannot be procured, a mixture of equal parts of nitre and muriate of ammonia, say ten ounces of the mixed salts to one pint of water. Ether allowed to evaporate on the surface of the tumour forms a good substitute for these remedies. Care must be taken that the cold be not so applied as to freeze the scrotum, and bring on sloughing.

The tobacco enema is not much used now, in consequence of the fatal effects which have appeared to result from its use. Six ounces of the preparation in the London Pharmacopœia are sufficient for one injection. The tobacco smoke is more troublesome in its application, and less certain in its effects.

Advantage should be taken of the weak state of the patient induced by these several remedies, and the taxis tried.

What length of time may we safely expend in our attempts at reduction before we proceed to the operation? To this question, perhaps the most important connected with hernia, no definite answer can be given. It depends altogether on the nature of the case, the form of hernia, the age, the constitution of the patient, and the urgency of the symptoms. Thus we can wait longer in the chronic than in the acute strangulation, in the old than in the young subject, in oblique inguinal than in direct inguinal or femoral hernia, and in cases of long standing. Larrey relates a case that proved fatal in two hours, whilst others have occurred where many days have passed over before the operation was performed, and yet with success.

On this subject the words of Mr. Hey are invaluable; that eminent surgeon says: "I have now, at the time of writing this, performed the operation thirty-five times, and have often had occasion to lament that I had performed it too late, but never that I had performed it too soon." After the operation an enema should be administered to the patient, so as to bring on a discharge from the bowels, and all symptoms of peritonitis combated by the antiphlogistic treatment.

If the operation be not performed in proper time, gangrene will take place. All the symptoms now undergo a complete revolution; the patient will say, perhaps, that he is much better, that he has got rid of all his pain, but a little examination will satisfy the practitioner that death is fast approaching. The pulse becomes weak, intermitting, and easily compressed; the abdomen becomes less tense and tender, the patient gulps the fluids from his stomach without any action of the abdominal muscles, and the skin is covered with a clammy perspiration. The tumour may be perhaps, by a little pressure, returned into the abdomen; it feels emphysematous; the bowels become relaxed, and hiccough supervenes. In this state but little can be done; the tumour should be cut into so as to give exit to its contents, and expedite the separation of the sloughs. The recovery of the patient is possible by the formation of an artificial anus.

The appearance of hiccough in the *advanced* stage of strangulated hernia is a bad symptom; it may however appear in the *early* stage, and yet the case terminate favorably.

POST-MORTEM EXAMINATION.

On cutting into the abdomen of a patient that has died of strangulated hernia, a quantity of air immediately escapes from the peritoneal cavity; the intestines appear as if they had been *tossed about* in the abdomen; those above the stricture are much distended, whilst those below it are contracted. The *surface of the peritoneum*, especially where it invests the intestines, is covered irregularly with a brownish-coloured tenacious lymph, which glues the viscera together.

The *pelvic cavity* contains a quantity of brownish-coloured serum. The intestines, where the convolutions touch each other, "have a red line upon them." On removing the lymph which covers the intestines, they appear more vascular than is natural. When the hernial sac is cut into, a quantity of lymph is found in the surrounding cellular tissue, and if gangrene have taken place, the parts will be emphysematous, and pit on pressure. A large quantity of serum will be found in the *hernial sac*, especially if intestine be present. The *omentum* is dark-coloured, and if gangrenous gives way to pressure, and emits a highly putrefactive odour. The *intestine* is covered with a layer of coagulated lymph. If gangrenous, *small green spots* will be seen upon it; it also yields to pressure.

GONORRHŒA.

Gonorrhœa is a discharge of purulent matter from the urethra of the male, the vagina, nymphæ, &c. of the female, the consequence of a specific inflammation, induced by the contact of infectious matter. Gonorrhœa usually appears on the third or fourth day after the application of the gonorrhœal matter; it may, however, commence in a few hours, or not appear for some weeks after. The first symptom of gonorrhœa is, generally, an itching at the orifice of the urethra, and sometimes extending over the whole glans; sometimes its earliest symptom is the sensation of a few drops of urine being lodged in the urethra, or even a slight heat near the extremity of the urethra. A little fulness of the lips of the urethra is next observable, the glans becomes swollen, and the discharge commences. The itching changes into pain, more particularly at the time of voiding the urine. There is often no pain until some time after the appearance of the discharge, and other symptoms; and, in many gonorrhœas, there is hardly any pain, even when the discharge is very considerable. At other times a great degree of soreness occurs long before any discharge appears. There is generally a particular fulness in the penis, and more especially in the glans. The glans has a kind of transparency, especially near the beginning of the urethra, where the skin becomes distended, smooth, and red, resembling a ripe cherry. The orifice of the urethra is, in many instances, excoriated. The surface of the glans itself is often in a semi-excoriated state, consequently very tender, and it secretes, as also the inner surface of the prepuce, a kind of discharge. The stream of urine becomes smaller than usual, from the swollen state of the penis, and the spasmodic contraction of the urethra, and is generally scattered and broken as soon as it leaves the passage. Some bleeding occasionally occurs from the urethra.

As the disease advances, the discharge increases in quantity, and the scalding in passing urine becomes much aggravated; the patient complains of a soreness and pain, and uneasiness about the pelvis, scrotum, and perineum, and the testes often become tender. The constitution now begins to sympathize, and general fever appears. The discharge in gonorrhœa is first of a thin serous character, it then resembles mucus, and finally assumes a purulent character; it is of a greenish colour, has a peculiar disagreeable smell, and stains the linen of a green colour. It proceeds at first from the anterior part of the mucous membrane of the urethra, one inch and a half of which only is engaged in the inflammation; this soon spreads, so as to occupy the whole of the canal and engage the lacunæ. The mucous membrane is not ulcerated, unless in the aggravated form of the disease, the discharge proceeding from the surface of the membrane.

Treatment of Gonorrhœa. In the early stages of this disease, it is best to observe the antiphlogistic regimen: thus, purgative medicines, and those of a saline nature more particularly, should be administered, and the patient confined to the drinking of mucilaginous fluids, such as linseed-tea, barley-water, weak gruel, &c.; all food of a stimulating nature should be avoided. When the more acute symptoms have subsided, the balsam of copaiba, cubebs, and liquor potassæ will be found useful, as also the occasional use of opiates. Fomentations and leeches also will be found beneficial. The copaiba balsam often disagrees with the patient, producing nausea and purging, and in some constitutions general fever, attended with a peculiar eruption of the skin. In the advanced stages of gonorrhœa astringent injections, such as those of the sulphate of zinc or copper, the acetate of lead, acetate of zinc, or corrosive sublimate may be used. Many surgeons object to the use of injections, on the grounds of their giving rise to stricture. Some have recommended treating gonorrhœa from the outset by means of strong irritating injections. For this purpose they have used the solution of nitrate of silver, gr. xx to ℥i of water. This plan will occasionally succeed, but more frequently fails, and often adds much to the patient's sufferings: the practice is dangerous. The internal use of mercury, as a specific in gonorrhœa, cannot be too strongly reprobated. In favorable cases of gonorrhœa, the symptoms gradually subside, the discharge lessens in quantity and changes in colour, loosing its greenish tinge, and finally disappears. On the contrary, some unpleasant symptoms, in general, attend the disease: the principal of them are chordee, bubo, retention of urine, hernia humoralis, hemorrhage, phimosis, and paraphimosis, stricture, &c.

Chordee. This is characterized by a curved state of the penis during erection, attended with great pain, and frequently a discharge of blood. It appears as one of the earliest attendants of gonorrhœa, and is caused by an effusion of lymph into the cellular tissue of the corpus spongiosum urethræ, which prevents the regular distension of the part. It is treated with fomentations and leeches, applied externally, followed by the camphorated mercurial or belladonna ointment, or a mixture of them; opium being administered internally, combined with camphor.

Bubo. This is also an early symptom. In general a number of the glands in the groin become enlarged, the absorbents leading to them being also increased in size, and forming a thickened chord along the dorsum of the penis. It is *sympathetic and rarely suppurates.* It is best treated with cold lotions, and leeches if the inflammation be severe, and careful rest.

Retention of urine. This occurs during the inflammatory stage of gonorrhœa, especially where much irritability of the neck of the bladder has been present, and the disease has been treated on the irritating plan. The symptoms are extremely acute, and there is much constitutional disturbance present. In some cases the patient is unable to pass any urine; in others, he gets rid of a few drops with much pain and suffering. The warm bath, leeches to the perineum and above the pubes, bleeding from the arm if the patient be plethoric, and emollient enemata, followed by the use of anodynes, should be resorted to before the catheter is had recourse to: by this treatment relief is almost invariably obtained. Retention of urine from gonorrheal inflammation may prove fatal, from the supervention of peritonitis.

Abscesses frequently form along the course of the urethra, or in perineo, in severe cases of gonorrhœa. In the former, they seem to be caused by inflammation attacking the lacunæ, in which the abscess is formed, and then bursts into the urethra; in the latter, Cowper's glands are in general affected; these may burst either into the urethra or in perineo, thus giving rise to a fistula in perineo. The cavity of the abscess should be laid open, and the wound dressed from the bottom, a catheter being retained in the urethra, so as to prevent the urine passing through the opening in perineo, if the patient do not suffer too much from its presence. As these abscesses frequently cause retention of urine before bursting, an accurate examination should be made whenever they are suspected to exist.

Hernia humoralis (*Testitis* or *orchitis*) appears in the advanced stages of gonorrhœa, when the discharge is rather of a gleety description, and is apparently about to disappear. It has been much disputed whether this is a specific affection of the testes or a purely inflammatory one. The latter opinion is that generally received, the disease being attributed to an extension of the inflammation from the urethra, along the vas deferens, to the testis. The disease usually commences with pain in the course of the vas deferens, and some swelling and tenderness in the spermatic chord; obtuse pains soon appear in the epididymis and testis, followed by acute inflammation of these parts. The pain now becomes more severe, and constitutional symptoms supervene; and, on examination, the epididymis and testis are found much enlarged, particularly the former, and are exceedingly tender to the touch; the testis retains somewhat of its natural shape, being flattened at the sides, and is exceedingly hard and tense; the scrotum becomes red, and its temperature is increased. Only one gland is affected at a time. There is pain in the course of the spermatic chord, extending to the lumbar region, general febrile disturbance, with nausea or vomiting.

The *treatment* consists in enjoining strict rest, and the supporting of the testis; the application of leeches, or opening the veins of the scrotum; fomentations, emetics, and purgatives; and, if the inflammation be very acute, the abstraction of blood from the arm. Cupping on the loins is also serviceable. By this treatment the inflammation subsides in the course of a few days, but leaving some hardness of the testis and epididymis, which is long in disappearing. The use of camphorated mercurial ointment will expedite the removal of this symptom. The discharge from the urethra usually disappears as soon as the testis becomes affected, returning when the inflammation of the gland has subsided.

Should hernia humoralis be neglected, the inflammation of the gland proceeds to suppuration, and an abscess is the result; this, by degrees, bursts on the anterior part of the scrotum, when the matter, mixed with semen, is discharged, as also a portion of the tubular, or secreting portion of the gland; fungous granulations now form from the interior of the testis, and a tumour is the result, forming *fungus* or *lipoma* of the testis. This fungus may be removed by the use of the actual or potential cautery, by excision, ligature, or the strong solution of nitrate of silver. Where the last-mentioned remedy is likely to succeed, it should be preferred; where it fails, the nitric acid or chloride of antimony claims a preference over other applications. As soon as the slough formed by these remedies separates, healthy granulations appear, which, contracting, close the opening in the scrotum, when the case gets well. The gland in these cases is generally destroyed.

Hemorrhage sometimes takes place during a gonorrhœa. It is seldom serious, and is often the forerunner of the entire disappearance of the disease. Should it be alarming, a silver catheter may be introduced into the bladder, and a roller bound tightly round the penis; in general the application of cold water will be sufficient to restrain the bleeding.

Gleet is a discharge of a thick mucus, which remains for a length of time, sometimes for months, after the acute symptoms of gonorrhœa have subsided. It in general depends on a relaxed condition of the parts. The use of astringent injections, tonics, and cold bathing will be found serviceable.

Phymosis and *Paraphymosis* are not unfrequently met with in connexion with the early stages of gonorrhœa; they will be described under the head of Venereal Disease.

ON STRICTURE OF THE URETHRA.

Stricture is an obstruction to the flow of urine throug the urethra, caused by the spasmodic action of the mus cles, or some alteration in the size of the canal, and i one of the most frequent, though remote, consequence of gonorrhœa, seldom appearing till some years after thi disease has disappeared. Its supervention to gonorrhœa ha been attributed to the use of astringent injections rathe than to the gonorrheal inflammation; but this may b well questioned. Strictures occasionally form in indi viduals who have never had an attack of gonorrhœa; indeed, the most severe forms of the disease result from mechanical injury to the urethra, such as falls on the perineum, &c. Strictures have been divided into the *permanent*, *spasmodic*, and *mixed*. By *permanent* strictures are meant those depending upon a permanent alteration in the size of the canal, caused either by an effusion of lymph into the submucous cellular tissue of the urethra, or on the surface of the mucous membrane. *Spasmodic* stricture is that caused by the spasmodic contraction of the muscular fibres surrounding the urethra. *Mixed* stricture is that in which the prominent form of the disease is attended with a spasmodic contraction of the surrounding muscles. Permanent strictures are divided into the *packthread*, *bridle*, and *long continued:* the packthread is that in which there is a circular narrowing of the canal, as if a thread were tied tightly around it; the bridle stricture is when a band of lymph crosses the urethra; and the long continued that in which a considerable longitudinal extent of the canal is engaged, and may be either on one or other of its surfaces, or occupying its whole circumference. The most usual seat of stricture is about the bulb, but there is much difference of opinion as to its precise situation; some contend that it is most frequently met with in front of, others say behind, the bulb; there is no part of the canal wholly exempt from the affection.

The earliest symptom of a stricture is the retention of a few drops of urine in the urethra after the patient has made water, which afterwards escape and wet the linen; while a further portion of urine is collected between the neck of the bladder and the stricture, and may be expelled by pressure on the lower surface of the urethra. This is soon followed by an irritable state of the bladder, the patient being frequently disturbed at night to pass water; the stream of urine becomes forked, spiral, or scattered, and, in a more advanced stage, the water is only voided in drops; there is, in general, a gleety discharge from the urethra, and uneasiness about the perineum and lower part of the rectum, &c.

When the stricture has existed for some time, the constitution begins to participate in the affection: a species of low fever setting in, marked by an accelerated pulse, impaired appetite, thirst, disturbed rest, and a peculiar degree of general irritability. As the disease advances, the fever assumes much of the character of an intermittent attack, being attended with occasional shiverings, followed by profuse sweatings. This may be distinguished from an intermittent by the irregularity of the attacks and the profuse nature of the sweatings. When the above symptoms are present, the urethra should be examined with a soft wax bougie, that the precise situation of the stricture, its size, shape, &c. may be ascertained. This having been done, the cure is proceeded with by means of bougies or catheters, gradually adapted to the state of the canal, one of these being passed at intervals of two or three days, until the stricture is removed by the mechanical pressure of the instrument, and the increased action of the absorbents excited thereby. In few cases can the instrument be passed more frequently, as its use is likely to be followed, particularly in irritable persons, by an attack of fever, such as we have just described, and generally known by the name of *stricture fever*. In this way, it is generally some weeks or months before the stricture is removed. At the same time that the bougie is being used, the constitutional symptoms should be attended to, and opiates and other medicines administered as they may be required. After the removal of the stricture, the patient should be directed to have a bougie passed occasionally, to prevent the return of the disease. In passing a bougie, or other instrument, into the urethra, the instrument is sometimes grasped by the spasmodic action of the muscles which surround the canal here; the instrument should be allowed to remain until the muscles have fatigued themselves, when it may be passed without difficulty. In obstinate cases of stricture, the catgut bougie will be found useful, as on being introduced through the stricture it will become distended by the moisture of the urethra, and thus act more powerfully on the stricture. Much caution is requisite in passing instruments along the urethra, as false passages may otherwise be formed. Some prefer the catheter to the bougie, in the treatment of stricture as it may be left for some length of time in the urethra, the urine flowing off through its cavity. Instruments, however, when left in the urethra, are frequently the source of much local irritation, and often induce a severe attack of stricture fever. Metallic instruments have been frequently used for the purpose of forcing the stricture: they are now seldom resorted to, for any violence is almost invariably followed by severe local and constitutional disturbance.

Caustic bougies, as they are called, are occasionally used for the removal of a stricture. They are made by inserting a piece of caustic, either the nitrate of silver or potassæ hydras, into a hollow in the end of the bougie. The precise situation of the stricture is first to be ascertained, by means of a common bougie; then the caustic bougie is to be passed down, and kept applied to the stricture for one or two minutes. These instruments are only used in very irritable and resisting strictures. When the stricture is very irritable, the caustic potash is preferred; but when it occupies a large portion of the canal, and is of unusual firmness, the nitrate of silver is more frequently used. Caustic bougies have latterly fallen into disuse, as their application is frequently followed by retention of urine, a severe attack of fever, inflammation of the urethra, followed by inflammation of the perineum, and abscess, or by hemorrhage on the separation of the sloughs. In one case of hemorrhage, Sir A. Cooper was under the necessity of dividing the artery of the bulb, to restrain the bleeding. Mr. Stafford's instruments for dividing strictures have not been generally adopted by the profession.

Spasmodic stricture, being caused only by the spasmodic contraction of the muscles of the urethra, is only temporary. It is treated by means of opium and other antispasmodic medicines. The bougie will also be found useful, by diminishing the irritability of the canal, and thus removing the principal cause of the spasm of the muscles.

The following may be considered as the principal after-consequences of stricture.

Retention of urine. This seldom makes its appearance suddenly, unless when much spasm is present; in general the stream of urine has been gradually diminishing for some time, and then the patient, from some excess or exposure to cold, brings on a complete retention of urine. The symptoms of the affection are an extreme desire to pass urine, attended with a total inability to do so, or nearly so, a few drops only making their appearance with much straining; a sense of weight and fulness in the bladder and lower part of the pelvis, and the presence of a *circumscribed* tumour, formed by the distended bladder, above the pubes. In many cases the last symptom is absent, as the bladder does not rise above the pubes, in consequence of its being in a permanently contracted state. Here, by passing the forefinger of one hand into the rectum, so as to support the inferior fundus of the bladder, whilst we tap with the other hand, above the pubes, the fluctuation of the urine in the bladder becomes at once evident, unless when very much distended; here the presence of the swollen viscus, as felt through the rectum, is sufficient to point out the case.

If we meet with a case of this kind, shortly after its commencement, we may administer an emollient enema, followed by an anodyne draught, apply leeches to the perineum or above the pubes, and use the belt, before we make any attempt to pass the catheter. At one time, the muriated tinct. of iron, given in doses of from ten to fifteen drops every quarter of an hour, was much extolled for giving relief in cases of retention of urine from stricture: more general use has not borne out the character originally bestowed on this medicine; in some cases it has proved of much use, but in many others has wholly failed. When the retention has existed for some time, we must at once have recourse to the instrument, a small one being selected for obvious reasons. Should the instrument pass, it is better that it should remain in the bladder as long as the patient can bear it without much inconvenience.

Where we cannot succeed in passing the instrument, and the symptoms become urgent, some mode of drawing off the urine must be adopted, either by tapping the bladder or by cutting down on the stricture: of these, the latter is to be preferred.

Tapping the Bladder. Two situations present themselves for this purpose, above the pubes and through the rectum.

The operation of tapping the bladder *above the pubes* is performed in the following manner:

Make a vertical incision, from an inch and a half to two inches in length, through the linea alba, immediately above the pubes, pass in one or two fingers of the left hand, to draw up the peritoneum, and feel for the distended bladder; through the lower part of the incision introduce the trocar and canula used for this purpose, directing the instruments downwards and backwards, or on the axis of the bladder. The viscus being penetrated, withdraw the trocar and pass through the canula, before the urine can flow out, a gum-elastic catheter, over which the canula is to be withdrawn. The urine now flows through the catheter, and the operation is completed. It is objectionable to leave the canula in the bladder, as, from its shortness, it may slip out of that viscus, or, should it retain its place, it will irritate and inflame the mucous membrane. The catheter may be allowed to remain in the bladder for two or three days, when the opening will have become sinuous from the effusion of coagulable, lymph, and the catheter may be with safety removed. Three very formidable objections exist to the performance of the operation of tapping the bladder above the pubes: the first is, the danger of wounding the peritoneum and small intestines; the second, the risk there is of the urine becoming extravasated in the cellular tissue about the bladder; the third, that the bladder is almost always so contracted in cases of long-continued stricture of the urethra, that it will not rise above the pubes.

Tapping the bladder through the rectum. The patient being placed on his hands and knees, or as in the operation of lithotomy, introduce the two forefingers of the left hand into the rectum, and feel for the triangular space, on the inferior fundus of the bladder, immediately behind the prostate gland. With the right hand pass the trocar and canula, the point of the trocar being retained within the canula, guided by the forefingers of the left, upwards and forwards (supposing the patient to be in the erect position) through the rectum into the bladder; withdraw the trocar, allowing the canula to remain, and the urine flows off. It will be necessary, as in the operation above the pubes, to retain the canula in the bladder for a few days, until the canal between the cavities of the bladder and rectum become sinuous. The principal objections to this operation are the risk of wounding the peritoneum, prostate gland, vasa deferentia, and vesiculæ seminales, and the inconvenience which arises from the irregular discharge of the urine through the rectum, which is frequently excoriated by this acrimonious fluid.

After tapping the bladder we should endeavour to restore the natural passage as rapidly as possible.

Cutting down on and dividing the stricture. Place the patient as in the operation of lithotomy, pass a grooved staff down to the stricture, make an incision along the raphe of the perineum down to the urethra, lay open this canal, dividing at the same time the stricture. Withdraw the staff, introduce a gum elastic catheter into the bladder, and heal the wound in perineo from the bottom. This operation is to be preferred, and will, we venture to say, soon supersede all other operations for the relief of retention of urine, as it not only removes the immediate sufferings of the patient, but the original disease also. Some recommend opening the urethra, through the perineum, with the trocar and canula passed into the canal behind the stricture: it has nothing to recommend it.

Extravasation of urine. When the retention of urine has not been relieved in sufficient time, the *urethra* gives way *behind* the stricture, (being weakened here from its being immoderately distended by the impulse of the urine against the stricture, and also by this fluid acting on the canal itself at this point,) where the urine becomes extravasated into the perineum, scrotum, penis, and upon the abdominal parietes. The rupture of the urethra is directly caused by the patient making an effort to pass urine; he feels something give way, and soon begins to experience relief from the previous symptoms of retention; to his surprise, however, no urine flows externally. At first the urine is confined to the perineum, but soon is forced upwards towards the scrotum, penis, &c. being prevented from passing in any other direction, by the attachment of the perineal fascia. If examined at an early period, there is but little external appearance present, there only being a more than usual fulness and hardness of the perineum; hence the case has been frequently overlooked. As the extravasation becomes more extensive, the scrotum and penis swell enormously, the integument is discoloured, first assuming a blush on the surface, then becoming of a dark red or purplish colour, indicative of approaching gangrene. So soon as the surgeon has ascertained that extravasation of urine has taken place, incisions are at once to be made into the several parts where the urine is lodged. The first incision is made in perineo, down to the urethra, in order not only to give exit to the urine already extravasated, but also to afford a free passage to that from the bladder, and thus prevent further extravasation, and to allow of the escape of any sloughs that may form. Other incisions are to be made in the scrotum, penis, and in the abdominal parietes; in fact, wherever the urine has extended itself; for, if this fluid be allowed to remain, it will cause extensive destruction of the cellular tissue and integuments with which it may have come into contact. As soon as all the sloughs have separated, and the wounds begin to heal, attempts should be made to restore the original canal. Most frequently the patients die from the irritation induced by the separation of the sloughs, before any attempt at a permanent cure can be made.

Catarrhus vesicæ. This is a chronic inflammation of the mucous membrane of the bladder, and one of the most frequent consequences of long-continued stricture. It is characterized by a frequent desire to pass water, which is discharged with a quantity of flaky mucus or purulent matter, and sometimes blood. The mucus, or purulent matter, is in general passed with much straining, after the urine has been evacuated; the former falls to the bottom of the chamber utensil, to which it adheres very tenaciously. The urine is of a pale colour, and soon emits a most fetid, ammoniacal odour. There is also pain in the region of the neck of the bladder, in the penis and lumbar region, and a certain degree of irritation of the rectum. The constitutional symptoms are those indicative of irritative fever. As the disease advances, it spreads along the ureters to the kidneys, which become affected in a similar manner, and not unfrequently form abscesses. In general the patient sinks under the affection before it has advanced thus far.

The *treatment* of catarrhus vesicæ consists in the administration of opiates, internally or by the rectum, of opiate injections into the bladder, and in the occasional exhibition of copaiba balsam, in small doses, liquor potassæ, decoctum uvæ ursi, decoct. pareiræ, mucilaginous drinks, &c. Relief may be obtained by these remedies, but they seldom effect a cure, unless the stricture be removed, and this only in the earlier stages.

Gonorrheal ophthalmia occasionally appears as one of the consequences of gonorrhœa, *vide* Diseases of the Eye.

Some patients when affected with gonorrhœa are liable to a more moderate inflammation of the eyes, accompanied with a rheumatic inflammation of one or more of the joints. The exhibition of the balsam of copaiba and the various forms of turpentine becomes necessary. These attacks are often both tedious and difficult of removal.

Secondary symptoms occasionally follow an attack of virulent gonorrhœa; they are generally papular eruption, pains in the joints, and a whitish patchy excoriation of the throat and fauces, and occasionally iritis.

Gonorrhœa in females attacks the labia, nymphæ, the orifice of the meatus urinarius, and vagina. The external parts become much inflamed, and tender to the touch. The treatment is the same as that in use in the male subject; local remedies, such as lotions, may be made of a much greater strength and injected into the vagina, when the acute inflammatory symptoms have subsided.

Young females are subject to a purulent discharge from the external parts of generation, from want of cleanliness during dentition, &c. This disease should be distinguished from gonorrhœa. It is cured by means of the lotio nigra, with the administration of rhubarb and calomel internally.

ON SYPHILIS.

The *venereal* disease, or *syphilis*, is contracted, like gonorrhœa, by the contact of infectious matter applied to some part of the body, most frequently the penis in the male, the labia in the female subject. It appears as a primary affection, in the form of a sore, named a *chancre*, and in the secondary affections in the form of inflammation and ulcerations on different parts of the body, the mucous membrane of the throat, the skin, periosteum, and bones.

A chancre generally appears within from four to seven days after connexion, but the time of manifesting itself is variable, and may extend to many weeks. Its usual seat is the corona glandis, but it may also form on the glans, prepuce, or body of the penis; indeed, on almost any part of the human body. The poison first produces a pimple on the part, of a darker hue than pimples in general, and attended with inflammation. The pimple bursting, an ulcer is formed in the centre, and then a pus is produced in the body of the sore, which is often large, and extends beneath the skin. The character of the sore is as follows: it is generally circular in shape; the surrounding edges are hard and ragged; its surface is yellowish, and the margin red; it is surrounded by an erysipelatous redness, and it possesses an indurated base.

The general *treatment* of chancre consists in the exhibition of mercury, in the form of blue pill, in the dose of five grains with a quarter of a grain of opium, night and morning, for a period of two to three weeks. The opium is of use in preventing the mercury from irritating the sore, or from passing off by the bowels. The local application of black wash is beneficial. The diet should be mild and unirritating, the patient avoiding acid drinks and much vegetable matter.

Although the symptoms above mentioned will indicate a chancre, still the constitution of the patient and many other causes will frequently prevent their development, and give to the sore appearances which may render its diagnosis difficult. Thus, when the poisonous matter is applied to a sore, excoriation, or fissure in the skin, it takes some time before the syphilitic symptoms appear in the ulcer. In these cases it is better to apply some common lotion to the sore, and wait to see whether it is venereal or not. If a chancre forms on the frænum, it usually destroys the part rapidly, unless mercury be given early; it is more irregular in appearance than chancres in other parts, and is in general more inflamed and painful. When a chancre forms on the edge of the prepuce, effusion takes place into the cellular membrane, inducing phymosis, as is also the case when the sore forms where the skin is reflexed over the penis. Chancres if situated on the corona glandis, or between it and the frænum, often extend deep, and produce sloughing of the part and of the glans itself. When a chancre extends through the skin into the cellular tissue, it assumes a disposition to ulcerate and slough.

The state of the constitution modifies the appearance of a syphilitic sore more than any other circumstance. In persons of an irritable habit, whether dependent on original formation, or induced by mode of living or pursuit, chancres inflame much, and run rapidly into sloughing. In this state, forming the *irritable* or *sloughing chancre*, the pulse will be generally from 120 to 130, an erysipelatous inflammation extends round the sore, and the sloughing attacks the body of the penis, which is rapidly destroyed. The exhibition of mercury, under these circumstances, is highly injudicious; antiphlogistic and soothing remedies should be resorted to, both locally and constitutionally, until the inflammatory and irritable state of the constitution has subsided. The extract of hemlock, musk, and opium, taken internally, are of much service in lessening the constitutional irritation; as local applications, the lotio nigra, lotio sulph. zinci, lotio flava, and poultices will be found most beneficial. Where the sloughing process is spreading rapidly, the nitric acid, or chloride of antimony, may be applied.

Chancres are sometimes treated by the application of caustic, which destroys the sore, a slough soon separates, upon which the ulcer heals up. Caustic will be found beneficial only in the first stages of chancre, and should not be used in an irritable state of the parts.

Phymosis is an elongated condition of the prepuce, which hangs over and conceals the glans. It is caused by inflammation, which terminates in an effusion of serum or lymph, or both, into the cellular tissue of the prepuce. Where the inflammation is violent, the antiphlogistic regimen is to be strictly observed, both locally and constitutionally; at the same time tepid water, or weak astringent lotions, should be injected under the prepuce frequently during the day. When sloughing attacks the prepuce, the fermenting poultice should be applied, and five grains of ammonia, with ten of musk, given two or three times a-day. The nitrous acid lotion will also be found useful. When the inflammation of phymosis subsides, the prepuce frequently remains enlarged; here it will be necessary to divide the prepuce with the bistoury, or it may be altogether removed.

Paraphymosis is the reverse of phymosis. In this, the constricted prepuce is retracted behind the corona glandis, and cannot be drawn forwards. The edge of the prepuce, constricting the corona glandis, will if allowed to remain cause a sloughing of the glans penis, or will liberate itself by acting on the constricted part. The strangulation is reduced by drawing the prepuce forcibly forwards: for this purpose, first compress the swollen glans, so as to empty its vessels; when this has been done, the skin of the penis is drawn forwards, the glans being pressed back at the same time. If this plan does not succeed, the stricture should be divided with the sharp-pointed bistoury.

Syphilitic Bubo. When a chancre has existed for some time, the absorbents take up the poison, and conveying it to the upper row of inguinal glands, produce an inflammation and swelling of these, forming a bubo: one gland only is usually enlarged from the syphilitic matter, but many may be sympathetically inflamed. A bubo may not form until after the healing of the sore, as its formation may be delayed by some other disease in the patient. Mercury should be exhibited as for the treatment of the chancre, and local remedies applied to lessen the inflammation: of these, leeches and cold evaporating lotions will be found most beneficial. It frequently happens that treatment will not prevent the gland from advancing to suppuration; this is indicated by sharp throbbing pains in the part; when these appear, the mercury should be laid aside, and purgative medicines administered; poultices and fomentations being applied at the same time to the swelling. As soon as fluctuation becomes manifest, a small opening should be made into the bubo with the point of the lancet, and the disease treated as a common abscess. If a bubo be improperly treated by a perseverance in the use of mercury sloughing will take place, producing the sloughing bubo. This affection is treated on the principles of mortification from any other cause. The sloughing not unfrequently extends to the iliac or femoral artery, when death is caused by hemorrhage.

Where a bubo is large, and contains much matter, it should be opened with the seton passed through it, or by the application of caustic; the latter is to be preferred where the skin is thinned to a considerable extent. Sinuses sometimes form in the treatment of a bubo; they should be laid open with a bistoury.

ON THE SECONDARY FORMS OF SYPHILIS.

The *secondary* forms of syphilis appear in three situations, namely, the mucous membrane of the throat and nose, the skin, and the periosteum and bones.

Secondary syphilitic diseases of the mouth and throat. When syphilis affects the mucous membrane, covering the floor of the nose, or roof of the mouth, the membrane becomes red and inflamed, and a pimple forms on it; when this opens, the bony palate is exposed, and may be felt with the probe. The exposed bone in some time separates, and a communication may be established between the mouth and nose, which gives a nasal sound to the voice, and allows of fluids passing from one cavity to the other. The discharge is thin and ichorous, and of very offensive smell. The tonsils also become affected with sores, having the characters of chancres. The throat feels dry, and the inflammation extends along the Eustachian tubes to the ear, producing acute pain and deafness. The mucous membrane covering the velum, and lining the back of the pharynx, is also liable to a similar state of ulceration. This not unfrequently extends to the cervical vertebræ, and proves fatal by the destruction of the bones, or the opening of the vertebral artery.

Syphilitic disease will extend from the throat into the larynx, where, inducing ulceration and thickening of the mucous membrane, it impedes respiration, and may prove fatal, by causing suffocation of the patient. It sometimes occurs, in these cases, that portions of the cartilages of the larynx become detached, and are spit up. Mercury should be exhibited for the cure of these affections of the throat and fauces, either internally or by means of mercurial fumigations: local applications, such as the lotio nit: argenti, linimentum æruginis, &c. being made use of to the sore. Should there be much inflammation present, this should be subdued before the mercury is commenced with. In this case, and also most other forms of secondary syphilis, the happiest results have been produced by the administration of iodide of potassium with small doses of iodine, and large quantities of the decoction of sarsaparilla. In syphilitic laryngitis the administration of calomel and opium, so as to bring the patient as rapidly as possible under the influence of mercury, will be most judicious, blisters and leeches being applied externally to relieve the inflammatory symptoms.

The mucous membrane of the cavity of the nose is occasionally attacked with syphilitic ulceration; a thin ichorous discharge, mixed with clots of blood, escapes, and is often followed by exfoliations of the spongy, and, at a later period, of the nasal bones, causing much deformity. In this affection mercury should be exhibited with much caution, as the disease may have been produced by the too great use of this medicine. Generally speaking, the use of astringent lotions, injected up the nose, and the exhibition of sarsaparilla, or the nitrous acid internally, will be most beneficial.

SYPHILITIC ERUPTIONS

Are liable to much variety. The most common kind met with is the copper-coloured eruption, in which the blotches rise a little above the surface of the skin, and, if they go on to ulceration, form thick incrustations. They are attended with very little pain; an itching, rather than a painful sensation, is felt in the part, and increases towards evening. In some, the eruption is of considerable magnitude, but is unattended with ulceration; in others, ulceration will be observed, with a very ragged edge. The parts in which venereal eruptions form most frequently, are the head, face, and roots of the hair, the back of the neck and shoulders, and palms of the hand, In some, the whole surface of the skin is covered over with the eruption. In many, the eruption is of the papular form; in others, the pustular will be found to predominate: the papular is the mildest form, and terminates by desquamation; the pustular frequently runs into ulceration. If the ulcerations be exposed, crusts form on the surface of the sores, particularly on the face and forehead; these rise to a considerable height, and assume a conical shape, and are named *rupia*. Eruptions are the earliest secondary symptoms of syphilis, appearing in general from the sixth to the tenth week after the formation of the primary sore; they are usually accompanied by sore throat and inflammation of the iris, and not unfrequently by pains in the head, joints, and bones. They are, in most cases, preceded by inflammatory symptoms, such as pains in the head and chest, imperfect rest, and general febrile disturbance.

The *treatment* of these eruptions consist in the exhibition of the blue pill, night and morning, if much inflammation be not present; if this should be the case, the plummer's pill may be given, with sarsaparilla, and the inflammation of the skin controlled by the warm bath and diaphoretic medicines. Nitric acid will also be found useful, particularly when much mercury has been already given, and the constitution of the patient is in a debilitated state. The iodide of potassium, with sarsaparilla, is attended here also with signal benefit.

SYPHILITIC DISEASES OF THE PERIOSTEUM AND BONES

Are later in their appearance than those of the skin. The long bones, which are exposed and are uncovered by muscles, are most liable to them; such as the tibia, fibula, ulna, and clavicle; the femur and humerus are but rarely affected. The flat bones of the head, particularly the os frontis and os parietale, are also attacked with secondary syphilis. Of the irregular bones, the sternum is most subject to syphilitic attacks. The symptoms by which syphilitic diseases of the bones are known are as follow: the patient experiences, in the evening, a sensation of pain in the bone, which is afterwards the seat of the node, this pain does not immediately produce a swelling, but, in the course of a few days, a swelling appears in the evening, and disappears on the following morning. It is tender and painful in the evening; but these symptoms are scarcely perceptible in the morning. At this time, the periosteum only is affected; but soon after, a deposit takes place between it and the surface of the bone: this deposit is, in the first instance, only a serous fluid, but a cartilaginous substance is soon secreted, which is gradually converted into bone, forming a node.

The *treatment* of this affection is the same as that for other forms of syphilis, namely, the exhibition of mercury. If there be much pain present, leeches or blisters may be applied to the parts. If the bone is enlarged, the emplastrum ammoniaci *c.* hydrargyro, or a blister, will sometimes cause the absorption of the osseous deposit. A quantity of serous fluid is sometimes found fluctuating between the periosteum and bone. When this is unattended with any inflammation of the skin, it is better not to cut down upon the bone, for if this is done, exfoliation will most likely be the result; blisters, in conjunction with mercury, will in general cause the absorption of the tumour. When, on the contrary, redness and pain are present in the part, indicating the presence of matter, an incision should be made immediately through the periosteum. Caries of the bone and exfoliation often take place (notwithstanding all our efforts to the contrary), which exhaust the patient's strength, and, in the bones of the head, induce inflammation of the dura mater and brain, destroying life, by the formation of matter in the interior of the cranium.

The fœtus, in utero, may be impregnated with syphilis from the mother. The symptoms manifest themselves within twenty-four hours after birth, the palms of the hand, the soles of the feet, and the nates become covered with a copper-coloured eruption, and the nails generally begin to fall off. Mercury should be administered to the mother, and will, by means of the milk, be communicated to the child.

ON WARTS.

Warts frequently form on the glans penis, in consequence of the application of matter from similar productions, or of a diseased action in the glandulæ odoriferæ. They were formerly supposed to be syphilitic, but are now known not to be so. Local applications, such as the liquor plumbi diacetatis dilutus, lotio nitratis argenti, acetic acid, and solution of bichloride of mercury will soon destroy them, by producing a sloughing of them, or by stimulating the absorbents to their removal.

Syphilis in females produces similar appearances to those observed in males. The primary sores form, in general, on the inner surface of the labia. A similar mode of treatment ought to be pursued.

The eye and testis are subject to disease in connexion with syphilis, although it is denied by many that these are syphilitic affections; they are treated of under the heads of Diseases of the Eye, and Diseases of the Testis.

DISEASES OF THE PROSTATE GLAND.

The prostate gland is seldom diseased, except in advanced life. Phlegmonous inflammation has been met with in the young subject, even before puberty. This may be caused by gonorrhœa, or other cases of inflamed urethra, or may appear as an idiopathic affection. It is characterized by considerable heat and pain in the region of the neck of the bladder, a frequent desire to pass urine, a sense of weight and fulness in perineo, and an irritable state of the rectum. Some fever is also usually present. Leeches to the perineum, fomentations, the warm bath, and purgative medicines will generally remove the affection. Should the gland become much enlarged, retention of urine will be the consequence: here the introduction of the catheter becomes necessary. In some cases, and particularly in scrofulous subjects, all our attempts to remove the inflammatory symptoms are ineffectual; they proceed to suppuration, which is indicated by the pain being dull and heavy, rather than acute, attended with shiverings and an accession of fever towards evening. If left to itself, the abscess will, most probably, make its way into the urethra, but may burst in perineo. Should any urgent symptoms be caused by the collection of matter, the abscess should be opened in perineo.

In more advanced life, the prostate gland is liable to a peculiar chronic enlargement, improperly termed scirrhus, for it is not malignant, neither does it present the fibrous structure of true scirrhus, nor ever degenerate into open cancer. One or both lobes may be affected with this disease, but the left is more frequently attacked than either the right or the middle lobe. It is looked upon as a remote consequence of gonorrheal inflammation, but has been known to occur in individuals who had never suffered from that disease. Being a chronic affection, it is sometimes many years increasing, before it causes serious inconvenience to the patient. At first there is some irritability of the bladder, as shown by frequent desire to pass urine, the stream of urine diminishes in size, and is with difficulty expelled, in many instances only dropping from the end of the penis; there is also a sense of fulness in perineo, and irregular pains about the neck of the bladder and rectum. As the disease advances, the difficulty of passing urine becomes greater, until complete retention takes place. This is seldom so urgent as retention of urine from gonorrhœa or stricture, as some urine in general dribbles away, which relieves the distended bladder. If the patient be examined per anum, the enlargement of the gland is easily felt. The effects of the enlarged gland on the urethra depend on the lobe or lobes affected: thus, if the left lobe be enlarged, the urethra is thrown to the right side, and vice versâ: if both lobes be affected, the canal is narrowed from side to side, whilst it is increased in the vertical direction, so as to resemble a mere chink, at the same time that the canal is also increased in length; the rectum is also pressed upon, so that there is usually some difficulty in passing the fæces, and these are often indented by the enlarged gland.

The *treatment* of this enlargement of the prostate gland consists in the occasional introduction of the catheter, and the removal of the irritability of the bladder, by means of suppositories or anodyne enemata. The catheter selected for the purpose should be of the gum-elastic kind, large and longer than those commonly in use, and provided with a stilet. As soon as the point of the instrument has passed down to the enlarged gland, by withdrawing the stilet the point of the catheter will be raised, and by pushing it gently forwards it will pass into the bladder; the same object may be obtained by pressing in perineo, or by the introduction of the finger per anum. The surgeon should bear in mind that, although some urine may escape, retention may still be present, the bladder relieving itself only of the superabundant portion of the fluid, which flows off without much effort on the part of the patient, the bladder being often in a paralyzed state.

In the advanced stages of the disease a quantity of viscid, ropy mucus is passed from the urethra; this is secreted in the prostate gland, as well as from the mucous membrane of the bladder. By the treatment mentioned, relief will be, in general, obtained, although a cure can scarcely be expected.

The middle lobe of the prostate gland sometimes becomes enlarged. It then presses upwards, towards the neck of the bladder, and here forms a valvular tumour, generally of a pyramidal shape, which obstructs the flow of urine, until this fluid has collected in such quantities as to pass over the sides or fundus of the swelling; hence a *stillicidium urinæ* attends this affection. The *treatment* is the same as that directed for enlargement of the lateral lobes. The enlarged middle lobe frequently becomes incrusted with calcareous matter; and hence, as also from the symptoms, has induced the idea of a calculus being in the cavity of the bladder. One very remarkable symptom present in the disease of a stone in the bladder, and generally considered as diagnostic, is a sudden stoppage of the urine, caused by the tumour falling against the opening of the urethra. The fixed point of the tumour in enlarged prostate will distinguish it from a calculus.

Calculi occasionally form in the prostate gland. They are usually small, numerous, and composed of the phosphate of lime. From their proximity to the bladder, and the symptoms produced by them, they may lead to the supposition of a calculus being contained in the bladder. When small, they escape frequently by the urethra; but when they have attained a large size, may become impacted in the canal, and so produce a retention of urine. If the calculus cannot be removed by dilating the urethra, as recommended by Sir A. Cooper, it should be cut down upon through the perineum, and thus removed. Much care is requisite in order to prevent its passing back into the bladder.

DISEASES OF THE TESTIS.

Hernia humoralis or *Testitis.* This is an acute inflammation of the testis, and most frequently appears in connexion with gonorrhœa. Vide Gonorrhœa.

Scrofulous disease of Testis. This, in general, appears about the age of puberty. The testicle becomes enlarged, but without much pain. If the disease be not arrested, numerous abscesses form in the testis, which burst externally, and discharge a scrofulous matter. The gland is almost always destroyed.

Hydatids of the Testis. This disease generally appears between the ages of seventeen and thirty. It begins at the extremity of the epididymis, where it joins the testis; both these parts soon become enlarged, but not painful. The veins of the spermatic chord become varicose. The constitution of the patient is unaffected. This disease will require removal of the testicle when it has attained a large size.

Irritable Testis. The part is so exceedingly tender that the patient cannot bear to walk, as pressure of the testicle gives him excruciating pain. Handling of the testis produces dreadful pain, which will last for hours after, passing up the spermatic chord to the loins, and along the nerves of the thigh. It may be relieved by the blue pill and hyoscyamus, but generally returns, and continues for months and even years. This disease often requires castration.

Sarcocele. The term sarcocele has been applied to almost every disease of the testis, in which this gland becomes enlarged; hence much obscurity has arisen with regard to diseases of this gland in general; we purpose confining the term to that enlargement of the testis which takes place in a syphilitic state of the constitution, (although Mr. Hunter denied the existence of such a disease,) and which may be therefore named *venereal sarcocele.* This is one of the latest of the secondary symptoms of the venereal disease, not appearing in most cases for years after the primary sore. It is, in general, accompanied with other symptoms of a venereal taint in the constitution, such as pains in the bones and joints, a few irregular syphilitic patches or ulcers on the skin, and not unfrequently a species of hectic fever, characterized by profuse night sweats, loss of rest and of appetite, wasting of the body, and great debility. One or both testes may be enlarged at the same time. The gland usually attains a large size, somewhat oval in shape, and slightly flattened at the sides. The integuments are not discoloured, nor is there much pain. The swelling is heavy, but not so much so as in the scirrhus testis. This disease is best treated with mercury, applied externally in the form of ointment, and taken internally in the form of blue pill or calomel, night and morning. By a perseverance in this plan to salivation, the disease rapidly disappears, and with it the constitutional symptoms.

Scirrhus Testis. This is a very rare disease. It appears in the advanced periods of life, and presents the same characters as cancerous tumours in other parts of the body. See Cancer.

Castration is the only remedy. This operation should be performed before the disease has extended itself to the spermatic chord or pelvic glands.

Fungus hæmatodes of the *Testis.* This disease is more frequently met with than scirrhus. Its characters are the same as in other situations, and will be seen under the article Fungus Hæmatodes. This disease is often confounded with hydrocele. Castration should be performed as soon as the nature of the disease has been ascertained, provided that the chord, or pelvic glands, have not become affected, or the general health of the patient does not indicate the affection to be constitutional.

Sclerocele. Mr. Ramsden described a peculiar enlargement of the testis under the name of sclerocele, which he conceived to be caused by an irritable state of the urethra, and which was only removed by the doing away with the inflamed state of the canal, by the use of bougies. The disease is not now acknowledged, although, in many cases, the state of the urethra will be found to have much influence on the testis.

Hydro-sarcocele. This is an effusion of serum into the tunica vaginalis, in combination with an enlarged testis. As the presence of the fluid often depends on the disease of the gland, when this is removed the other disappears. Should this not take place, the case may be treated as a simple hydrocele. In some cases the evacuation of the fluid at first becomes necessary, in order to make an examination of the state of the testis.

Castration is performed for the removal of malignant diseases of the testis, in cases of hydatids and irritable testis. The operation is performed as follows.

Grasp the testicle in the left hand, begin the incision at the upper part of the external abdominal ring, and extend it to the lower extremity of the scrotum, so that no bag may be formed for the lodgement of matter. Lay bare the spermatic chord at the ring, and tie the spermatic artery and artery of the vas deferens. Divide the spermatic chord, and dissect out the testicle from behind. The spermatic chord should not be divided until the arteries are tied, or the chord secured, so as to prevent its being retracted by the action of the cremaster muscle into the inguinal canal. Should this accident occur, it will be necessary to slit up the chord, in order to come at the bleeding vessels.

Tie any vessels that may bleed in the scrotum, and bring the edges of the wound together. When the scrotum has been much distended by the diseased testis, a portion of the integuments may be removed, by making two elliptical incisions, which will meet above and below.

Varicocele, *Spermatocele*, *Circocele*. These several names have been applied to a disease in which the spermatic veins become varicose. It is more frequent on the left than on the right side, from the termination of the left spermatic vein, in the left renal, which it joins at a right angle. The part of the chord below the external abdomidal ring is more subject to the disease than that above this point. It is known by the swelling of the chord, which, when felt, resembles a bag of earth-worms. It is attended with pains in the chord, extending into the lumbar region, and by a wasting of the testis. The testis should be suspended in a bag-truss, and leeches and cold lotions occasionally applied. The tying of the vein, as recommended by Sir E. Home, should never be performed. Varicocele is frequently mistaken for an inguinal hernia.

Hæmatocele is a term applied to a collection of blood in the sac of the tunica vaginalis, produced by a wound of a vessel of magnitude, in the operation of tapping a hydrocele, which pours its blood into the interior of the sac; or by a rupture of one of the vessels of the chord or scrotum from injury. It is distinguished from hydrocele by the history of the case, its want of transparency, the greater density of the fluid, and greater weight of the tumour. Evaporating lotions should be applied to the part, so as to cause the absorption of the effused blood: if these should not succeed, the tunica vaginalis should be cut into, and the effused blood removed.

An ecchymosed state of the scrotum, in which blood is extravasated in the cellular tissue of the part, is not unfrequent after operation near the scrotum, and injuries of it. The blood is generally absorbed in a few days.

ON HYDROCELE.

The term *hydrocele*, although applicable to any tumour containing water, in general indicates a collection of serum in the sac of the tunica vaginalis. It is a perfectly local disease, and occurs most frequently in the adult, or advanced periods of life. It is sometimes caused by injury, but more usually appears as an idiopathic affection. The fluid first collects in the bottom of the tunica vaginalis; but, as it increases in quantity, extends towards the external abdominal ring. When fully formed, the tumour is of a pyriform shape, with the base below; the integuments of the scrotum are distended and deprived of their corrugated appearance, the raphe is thrown to the opposite side, and the penis appears diminished in size. The swelling is light in proportion to its size, and fluctuation may be perceived, when the fingers of one hand are applied to one side of the tumour, and the surgeon taps slightly with the fingers of his other hand upon an opposite point of the swelling; it is also in general transparent. Hydrocele is unattended with pain or uneasiness, except such as is occasioned by its bulk, and its dragging on the chord, which frequently induces pain in the inguinal and lumbar regions. The testicle is situated to the back part of the swelling, and opposite about the junction of its upper with the two lower thirds.

When the above symptoms are present, hydrocele is easily distinguished; but this is not always the case; thus, it may be elongated in shape, or may present an hourglass appearance, in consequence of partial adhesions of the tunica vaginalis. Fluctuation cannot be always perceived, from the large quantity of fluid in the tumour, and consequently tense state of its coverings; it may be opaque from the thickness of the tunica vaginalis, or the dark colour of its contents, and the testis may be adherent to any part of the tunica vaginalis from previous adhesions.

Hydrocele, too, is sometimes accompanied by other diseases, which add to the difficulty of the diagnosis. The most frequent are hernia and enlarged testis. In the former, the hernial tumour passes down behind the sac of the hydrocele. Hydrocele may be confounded with other diseases: of these the most likely are hernia, enlarged testis, and fungus hæmatodes. It may be distinguished from a hernia by this commencing from above, by the difference in their shape, the open state of the external abdominal ring in hernia, and by the surgeon being enabled to feel the intestine, by grasping the chord immediately below the ring, and the difference in the relations of the testis in the two diseases. An enlarged testis is distinguished from a hydrocele by its greater weight, its more globular form, its want of transparency, and the history of the case. Fungus hæmatodes is the most likely of all the diseases of the testis to be mistaken for a hydrocele; but the irregularity in the feel of the tumour, its greater weight, and the absence of transparency, will point out the true nature of the affection.

The *treatment* of hydrocele is divided into the *palliative* and *radical*. The palliative treatment consists in the removal of the fluid, as often as it is collected, by means of tapping the hydrocele. The radical comprises, in addition, the exciting a degree of inflammation in the interior of the tunica vaginalis, whereby its cavity is obliterated, or a new membrane formed, so as to line its internal surface, and which does not possess a secreting power.

The palliative treatment is resorted to in cases where the hydrocele is accompanied with an enlarged testis, constituting the disease of hydro-sarcocele; in old persons, particularly when the hydrocele is large, and in cases where the tunica vaginalis is much thickened. As a general rule, the palliative treatment should be adopted before the radical is resorted to, in order to allow of an opportunity of ascertaining the condition of the testis, and selecting the most favorable state of the tumour, as regards its size, for the radical treatment. When the palliative treatment is decided on, the operation is performed as follows:

Place the patient in the erect posture, with his back supported against a table, or the wall; ascertain the situation of the testis, grasp the tumour a little below the external ring with the left hand, so as to force the fluid to the lower part of the tunica vaginalis, and thus protect the testis. With a lancet make a small incision through the skin of the scrotum, on the anterior part of the tumour, a short distance above its lower fundus, and in a part where no vessels of magnitude are seen. Introduce the trocar and canula into the tunica vaginalis; withdraw the trocar, allowing the canula to remain, and the fluid will flow off. The trocar should be directed first, backwards, as if towards the testes, but as soon as it has entered the tunica vaginalis, its point should be turned upwards, so as to avoid wounding this gland. When the fluid is drawn off, the canula is to be removed, and the wound dressed with adhesive plaster. It rarely happens that any bad consequences ensue from this operation, when properly performed. Two cases, however, are recorded, where it was performed in old persons, and in which it was followed by gangrene and death. Where then we operate in old persons, or bad constitutions, a few days' rest after the operation is advisable.

Many surgeons introduce the trocar at once without the previous incision by the lancet.

The radical cure is produced by injection, incision, excision, tent, caustic, and acupuncture. *Injection.* As soon as the water is drawn off from the tunica vaginalis, a stimulating fluid is injected into the sac, which is allowed to remain for a few minutes, and is then discharged. The canula is withdrawn, and the wound dressed. The best fluids, for this purpose, are port wine mixed with water, in equal proportions, or a little stronger or weaker than this, according to the irritability of the patient, and a solution of sulphate of zinc, in the proportion of ʒj to the pint of water; any other stimulating injection will answer.

When a case proceeds favorably, some inflammation appears on the second or third day after the operation, as indicated by heat, pain and redness of the scrotum, and a return of the swelling, the tumour frequently attaining as large a size as before the operation, caused by an effusion of serum into the tunica vaginalis. Towards the close of the week, the inflammation gradually subsides and the swelling disappears, so that the cure is completed in the course of ten days. The cure is accomplished by the effusion of coagulable lymph, which causes the complete or partial obliteration of the sac of the tunica vaginalis, by adhesion of its opposed surfaces; and those parts which do not adhere are lined by an adventitious membrane which has not the power of secreting. In general some enlargement of the testis remains after the operation, which may not disappear for many weeks.

In some cases the operation for the radical cure of hydrocele is not followed by sufficient inflammation; then the patient should be directed to walk about, and be allowed a generous diet, so as to excite the requisite inflammatory action. On the contrary, it may be followed by too great a degree of inflammation; here, the use of leeches, fomentations, purgative medicines, and a low diet become necessary, aided, if required, by bleeding from the arm.

If sufficient care be not taken in performing the operation of tapping a hydrocele, the testis may be wounded; this accident may be followed by severe inflammation of the gland, and may terminate fatally. Whilst injecting, too, the end of the canula may slip from out the tunica vaginalis, and the fluid will escape into the cellular tissue of the scrotum. The occurrence of this accident may be known, by the great difficulty experienced in impelling forward the fluid, and by its not escaping afterwards freely through the canula. When this mistake has occurred, incisions should be made at once, into the scrotum, so as to cause the discharge of the fluid, and prevent the sloughing of the scrotum, so likely otherwise to ensue.

The operation for the radical cure of hydrocele has been, occasionally, followed by such a severe degree o inflammation, as to induce mortification and sloughing of the integuments of the scrotum. In somewhat milde cases, abscesses have formed in the scrotum. In cases o hydro-sarcocele, where the hydrocele is complicated with an enlargement of the testis, it is better to remove th disease of the gland before resorting to the operation, as i occasionally occurs that, when the disease of the teste has been removed, the fluid in the tunica vaginalis be comes absorbed.

Excision consists in dissecting out and removing th tunica vaginalis. This is an exceedingly dangerous opera tion, and is now never resorted to. Some recommend the cutting away a small portion only. It is seldom practised except in cases where the tunica vaginalis is much thickened, and the operation by injection has failed to produce the requisite degree of inflammation.

Incision consists in cutting into the tunica vaginalis, and filling the cavity with lint. It is scarcely ever performed at present.

Tent. In this method of treating hydrocele, an incision is made into the tunica vaginalis, and a dossil of lint or piece of sponge introduced, through the opening, into the sac.

Seton. This operation may be performed by passing a probe, armed with a seton, (through the canula after or before the water has been drawn off,) to the upper part of the tunica vaginalis, where its extremity is cut down upon, and the instrument drawn through. The seton is preferred to the injection in children. It should be removed as soon as sufficient inflammation appears to be excited in the parts. Infants are subject to hydrocele. An operation is seldom required in them, as the use of stimulating lotions to the scrotum, in general, causes the absorption of the fluid.

Acupuncture consists in introducing proper needles through the scrotum and tunica vaginalis, leaving them there a short time and then withdrawing them; a little fluid escapes from the orifices, and an inflammatory action is set up, which sometimes leads to the absorption of the fluid in the tunica vaginalis. This, however, is prone to return, and the operation must be repeated. It is not adopted by the profession generally. It should be borne in mind that, in old cases of hydrocele, the component parts of the chord become spread out, and may be met with on the anterior surface of the tumour; thus the vas deferens or spermatic artery may be wounded, if sufficient care be not observed.

Hydrocele of the chord. This is a collection of fluid in a cyst, formed by the tunica communis of the chord, and appears most frequently in that part of the chord which lies between the external abdominal ring and the testis. It is elongated in shape, tense, and free from pain. The testis lies beneath it. It is treated either by injecting the cyst, or excising a portion of it, or by the introduction of a dossil of lint into its interior. Hydrocele of the chord may be confounded with a hernia, or a hydrocele of the tunica vaginalis. It is distinguished from a hernia by the absence of pain or tenderness, the want of impulse on coughing, and the non-existence of constitutional symptoms. It is distinguished from a hydrocele of the tunica vaginalis by the situation and shape of the swelling and the relative position of the testis.

Infiltration of serum into the cellular tissue of the chord has been described by surgeons under the name of diffused hydrocele of the chord. It does not deserve the name.

Congenital Hydrocele. This form of the disease results from the tunica vaginalis not having become obliterated at its upper part, so as to separate it from the cavity of the peritoneum. It is recognized by the fluid passing up into the abdominal cavity, when the patient is placed in the recumbent posture, and again descending when he assumes the erect posture. A truss should be applied so as to obliterate the communication between the cavities of the tunica vaginalis and peritoneum.

DISEASES OF THE RECTUM AND ANUS.

Hemorrhoids or *Piles.* These are, by far, the most frequent of all the diseases of the lower part of the rectum; but few individuals, past the meridian of life, being completely free from them. They are small, irregular, vascular tumours, of a dark bluish colour, which form around the margin of the anus, either within or external to the cavity of the rectum: hence divided into *internal* and *external.* Hemorrhoids are of two descriptions, consisting either of the dilated extremities of the hemorrhoidal veins, or of vascular organized tumours. These last are formed in the following manner: from some inflammatory action in the part, lymph or, according to some, blood is effused into the cellular tissue; the lymph or blood becomes organized, that is, vessels shoot into it, and thus the tumour soon attains a considerable size. In some cases hemorrhoidal tumours are productive of but little inconvenience, in others, on the contrary, and particularly when inflamed, they become exceedingly painful, and are productive of much suffering. In these, the tumours are tense, hard, and painful, the patient being unable to walk, sit, or ride, the only grateful position being the horizontal one. Should he, during the continuance of the inflammation, be obliged to pass a motion, the distress is extreme. With these symptoms there is more or less fever, and even sometimes delirium. Occasionally one or more of the tumours pour out blood, which gives relief.

The *treatment* of hemorrhoids consists in the use of leeches and fomentations to the part, laxative medicines, and diluent drinks. In the more chronic form, the use of some astringent ointment is beneficial. Some practice the opening of the hemorrhoidal tumours with the point of the lancet: when hemorrhoidal tumours are productive of much suffering and inconvenience their removal becomes necessary. This may be accomplished by excision or by the ligature. It is sufficient in general to remove one, the largest and most painful, of the cluster. If excision be preferred, the tumour is transfixed with a tenaculum, and at once cut away with a knife or scissors. If the ligature be deemed preferable, it is applied round the neck of the tumour, which soon sloughs away. Where the neck of the tumour is badly marked, a double ligature becomes necessary; this is applied by transfixing the hemorrhoid with a needle armed with a double ligature, one being tied on each side of the tumour. Excision is objected to by many, in consequence of the hemorrhage which so frequently follows its adoption. Should this ensue, the bleeding may take place into the rectum, which becomes filled with blood. The patient now conceives that he has a motion to pass, and, discharging the blood, frequently faints from exhaustion. When it can be practised, the bleeding vessel should be sought after, and secured with a ligature; if this cannot be accomplished, the application of cold or astringent lotions may stop the discharge.

When this does not succeed, plugging the rectum should be had recourse to. This is accomplished by first passing a large fold of lint or linen into the intestine, so as to form, when opened, a conical cavity, into which a sufficient quantity of lint is introduced to distend the bowel, and compress the bleeding vessel.

Ligature is objectionable from its inducing symptoms of peritonitis. Whenever these appear, the ligature should be at once removed. There is much difference of opinion as to the best method of removing hemorrhoids; perhaps excision is best adapted to external, the ligature to internal piles.

Hemorrhoids are a frequent source of inflammation and abscess at the side of the rectum, which almost invariably degenerates into a fistula. In unhealthy subjects, they often induce an erysipelatous inflammation of the surrounding cellular tissue and integuments, terminating, if not properly treated, in extensive sloughing and isolation of the lower part of the rectum. The *causes* which give rise to hemorrhoids are numerous; thus, confined or too relaxed bowels, an indurated state of the liver, dropsy, pregnancy, and diseased lungs, and exposure to cold have been known to produce them.

Condylomatous tumours sometimes form around the anus. They are removed by the use of astringent washes.

Painful fissures, particularly described by Dupuytren, occasionally occupy the margin of the anus. In mild cases, the belladonna ointment will be of service; in the more obstinate, the cutting through the fissures becomes necessary.

Fistula in ano is a sinuous canal or cavity at the side of the anus and lower part of the rectum, which opens either into the rectum, or externally, or in both situations, and discharges purulent matter. Fistulæ are the result of abscesses, formed in the cellular tissue around the rectum, and which, having burst or been opened, are prevented from healing by the action of the sphincter ani, and thus become sinuous or fistulous. Fistulæ in ano are divided into the *complete* and *incomplete*. The complete are those which possess two openings or outlets, one into the rectum, the other externally. The incomplete are those which possess but one aperture or outlet, and are subdivided into the blind external and blind internal. The blind external fistula is that which opens externally only, the blind internal, that which communicates with the interior of the rectum, without having any external opening.

The symptoms of a fistula are a feeling of soreness and uneasiness in the anus and rectum, especially when passing the fæces, at which time much pain is often felt; an irregular discharge of purulent matter, sometimes thin and fetid, but often perfectly healthy, which stains the linen, and is sometimes mixed with blood; there is often irritability of the neck of the bladder. There are also occasionally some febrile symptoms present in the constitution, but often the disease appears to be a perfectly local affection, not exciting any general disturbance; in many cases appearing to be rather beneficial than otherwise, and arresting the progress of some organic affection, to which the patient had been previously subject.

On examining a fistula, the external orifice, if it should exist, will be found small, circular, and possessing a slightly fungous appearance, and is in general concealed in the folds of the anus; its circumference is indurated. There is some, but not much pain on pressure. The discharge generally comes on at intervals, that is, the canal, from its opening being partially closed, becomes filled with matter, and, on evacuating the fæces, this is suddenly discharged. By introducing a probe the extent and direction of the fistula will be ascertained; generally it reaches to but a short distance within the anus; sometimes it extends to a considerable distance along the side of the rectum. The chief cause of the continuance of fistula in ano is the irritation kept up in it by the action of the sphincter ani, and consequently the division of the fibres of this muscle is necessary in the operation for the cure.

The *treatment* of fistula in ano consists in laying open the canal, so that its cavity may communicate throughout with that of the rectum. The operation is performed as follows: Place the patient, if a male, on his hands and knees, if a female, on her side; introduce a probe, so as to ascertain the extent and direction of the fistula, withdraw this, and pass up the probe-pointed bistoury, having previously introduced the forefinger of the left hand into the rectum, push the extremity of the bistoury into the intestine, and on it place the end of the finger in the rectum; draw down the instrument thus supported, cutting through the wall of the sinus into the rectum. The cavity of the sinus being laid open is to be filled with dossils of lint, passed into it from the rectum, so as to prevent union of the edges of the wound, and cause the cavity to fill up by granulations. If there should be a number of sinuses, they are to be laid into one. In some cases, where the fistula extends high up, we cut through the lower part of the sinus only; the fistula will afterwards heal up. In consequence of the peritoneum on the anterior, the hemorrhoidal arteries on the posterior surface of the rectum, it is not safe to cut higher than as far as the finger will reach without difficulty.

Abscesses connected with diseased spine, or sacrum, or scirrhous contraction of the rectum, phthisis pulmonalis, or other organic affections, sometimes burst by the side of the anus; such cases should be distinguished from a true fistula, as any operation on them is likely to aggravate the more serious affection, and will not succeed, although properly performed. When we are about to operate on a fistula, with but one opening, a second is to be made either with the lancet externally, or with the point of the bistoury into the rectum. If the fistula should be slow in healing, the use of stimulating applications will be found beneficial.

Prolapsus ani is most frequently met with in children. It consists of an eversion of the mucous membrane of the rectum, caused by a relaxed condition of it. The protrusion forms a large circular tumour, of a red, deep red, or purple colour. It should be at once returned, by making gentle pressure on the part, for if allowed to remain out, sloughing may be produced by the constriction of the anus on the tumour. The use of cold astringent lotions, a generous diet, and the various preparations of bark and iron, will sometimes prevent a recurrence of the disease. When these remedies are ineffectual, and the disease becomes troublesome, one or more folds of the mucous membrane of the rectum may be removed by the scissors; the contraction of the wounds, thus caused, will remove the affection in a great majority of cases.

Stricture of the rectum is divided into the *spasmodic* and *permanent*. The existence of the spasmodic is denied by many. Of the permanent there are two species, the simple permanent stricture, and the scirrhous or scirrho-contracted rectum.

Simple permanent stricture is caused by an effusion of lymph into the submucous cellular tissue, followed by a gradual contraction and condensation of the mucous membrane. It most frequently appears in adults, or advanced life, and in females oftener than in males. The symptoms are those which we should conceive to be produced by a mechanical obstacle to the passage of the fæces, viz., an irregular state of the bowels, sometimes constipated, sometimes relaxed, attended with colicky pains in the abdomen. The fæces are changed in form, according to the nature of the stricture, and much smaller than natural, unless when the disease is situated in the upper part of the intestine; then the fæces, accumulating in the lower part or cul-de-sac, may be expelled of the proper form and size. There is little or no pain attending the disease, except when passing the fæces, or immediately after, and this only in the advanced condition of the affection. Some obscure dull pains are usually felt about the lower part of the pelvis, and down the thighs; and not unfrequently an irritable state of the neck of the bladder exists. In this state of things the constitution begins to participate, the appetite becomes impaired, and general symptoms of dyspepsia, attended with some fever, present themselves. On examination of the intestine, the stricture will be felt by the finger, a short distance, in general, above the anus; in some cases it may be situated higher up, when the bougie will be required to ascertain its existence.

The *treatment* of stricture of the rectum consists in the removal of the stricture, as far as is possible, by the occasional use of the rectum-bougie, in the administration of opiates, either by the mouth or per anum, to relieve the irritability of the parts, or in the exhibition of such medicines, internally, as are best suited to the relief of the symptoms present. When the bowels are obstinately constipated, much benefit will be derived from the administration of emollient enemata, passed into the intestine, above the stricture, by means of the gum-elastic tube. In the more advanced stages of the disease, the mucous membrane, near to the stricture, becomes ulcerated, and a thin sanious matter, mixed occasionally with blood, is discharged per anum. Stricture of the rectum proves fatal, by inducing peritonitis, by the giving way of the intestine above the stricture, or by the constitutional irritation which it causes.

Scirrho-contracted rectum. This is a more formidable disease than the preceding: it occurs, in general, in advanced life. In addition to the symptoms we have mentioned, as characteristic of simple permanent stricture, there are the local and constitutional evidences of a cancerous disease. Thus, the patient complains of severe, lancinating pains in the part, extending through the pelvic viscera and down the thighs; there is a thin ichorous matter discharged per anum, mixed occasionally with blood. The constitution, too, presents all the characters of a cancerous diathesis. When the scirrhus degenerates into open cancer, all the symptoms become aggravated, a communication is frequently established between the rectum and bladder in the male, between the intestine and the vagina in the female, and thus the fæces and urine are discharged together. The patient soon sinks beneath the weight of his sufferings. But little can be done towards the removal of a scirrhus of the rectum; much, however, may be effected, in relieving the patient's suffering, by means of opiates. The use of the bougie is nearly impracticable, from the irritation it produces, especially in the ulcerated state of the disease. As a scirrhus of the rectum almost invariably commences in the lower part of the intestine, immediately within the anus, some have suggested its extirpation. We question if the success of the operation will ever be such as to justify its adoption.

Polypous tumours occasionally form in the rectum in the young subject. They are removed by ligature without difficulty.

ON ACCIDENTS AND DISEASES OF THE BONES AND JOINTS.

ON FRACTURES.

FRACTURE is a solution of continuity in one or more bones, produced by some force or violence extraneous to the bone itself. Fractures are divided into *simple, compound, comminuted,* and *complicated.*

Simple fractures are those in which the fracture does not communicate with the external air. They are by far the most frequent in civil life, and in general affect the shaft of the long bones, this part being, from the mechanism of the osseous structure, more exposed to the effects of shocks, or other violence, than the extremities of the bones, and being composed chiefly of the compact tissue. The flat bones, as of the head and pelvis, are also sometimes fractured, and generally by direct violence. Muscular exertion frequently causes fracture, as of the patella, olecranon process, and os calcis.

The general symptoms of a fracture are deformity of the limb, consisting of swelling, caused either by the overlapping of the bones, or effusion of blood, lymph, or serum into the cellular tissue; shortening produced at the time of the accident, or soon after, by the retraction of the lower part of the limb, by the spasmodic contraction of the muscles; crepitus, or a grating sound, when the ends of the fractured bones are moved one against the other; *complete* or *partial* loss of power; a certain degree of *pain*, aggravated by motion; a capability on the part of the surgeon to remove the deformity by moderate extension, on relaxing which the deformity is reproduced. If then we select a particular bone, let us say the shaft of the femur as an example for the rest, we shall find all the preceding symptoms. The deformity caused by the overlapping or projection of the bones renders fractures, especially of the superficial bones, at once evident either to the eye, or to the finger passed along in the direction of the bone supposed to be fractured. The *swelling* of the limb seldom sets in immediately after the occurrence of the accident, unless when a large artery has been ruptured either by the ends of the bone, or by the violence, in which case the blood is injected into the cellular tissue amongst the muscles, and sometimes immediately beneath the integuments; in this latter case the skin presents a dark livid appearance, and, when vesications form on the surface, as occasionally happens in simple fracture, is not unfrequently mistaken for mortification. The diagnosis, however, is simple, as the livid colour comes on immediately after the injury, the parts retain their temperature and sensibility, and the vesications are tense, circular in shape, and filled with a straw-coloured, transparent fluid, in which they differ from the vesications of gangrene. The extent of the shortening of the limb is variable, depending on the nature of the fracture and the power of the muscles attached to the bone. In some cases there may be no shortening, as in cases of transverse fracture, unattended with displacement of the fractured extremities. In no case of fracture, excepting that of the olecranon and neck of the scapula, have we lengthening of the extremity. In endeavouring to ascertain whether the injured limb is shorter or not than the other, we should be careful that the patient lies perfectly straight, as otherwise the limb may appear to be shorter when such is not the case: this mistake is more likely to take place in the lower than in the upper extremities. Crepitus is sometimes indistinct, as in fracture of the lower extremity of the fibula or radius, where the bone is fixed by ligaments, and is supported by the opposed bone, or in fracture of the neck of the femur, where the fracture lies deep, and the bones can with difficulty be brought into apposition. When examining for a fracture near to an articulation, we should be careful not to confound crepitation with the grating of the synovia in the interior of the joint.

The *loss of power* of the limb is a necessary consequence of the muscles having lost the resistance of the bone, so necessary for their action, independently of the injury done to the soft parts themselves by the violence that has caused the fracture.

The extent of *pain* varies much in fractures. In general it is not severe unless when the limb is moved.

The capability of reducing the deformity by means of extension, and its return when the extending force ceases, forms an important distinguishing feature between fractures and dislocations.

A bone may be fractured in the *transverse*, *oblique*, or *longitudinal* direction. The last is seldom met with, and only when the violence is applied directly to the bone, as in gun-shot wounds. It is always desirable to ascertain *à priori* whether the fracture is transverse or oblique, as the former, when placed in apposition, is kept so without much difficulty, whereas the latter is liable to displacement at each contraction of the muscles, or in any motion of the parts; hence much more care is requisite after such. A different line of treatment is required in the oblique than in the transverse fracture. In treating the oblique fracture the position of the limb is of much consequence; it should be placed in such a position, if possible, as will relax the principal muscles connected with the fractured bones. In the transverse fracture the straight position is often preferable, as here the bellies of the muscles support the bones, and they are in this position less under the influence of active muscular contraction.

A fractured bone may be *displaced*, 1st, in such a manner that the upper overlaps the lower portion of the fracture; this is the most frequent displacement, and occurs from the muscles acting principally on the lower part of the limb: 2dly, so that the lower overlaps the upper fracture; this is rare: 3dly, in the lateral direction; that is, when one fractured portion is thrown to the side of the other; 4thly, so as to form an angle salient either anteriorly or posteriorly; 5thly, in regard to the circumference of the fractured bone; that is, when the bone is rotated on its own axis, so that the lateral and posterior surface of one part may correspond to the anterior surface of the other portion.

TREATMENT OF FRACTURES.

The treatment of fractures is comparatively simple; it consists in restoring the bones to their natural position, securing them in that state, and finally obviating or removing any unpleasant symptoms that may be likely to occur, or have chiefly taken place. It is only when the bones have undergone displacement that the surgeon is required to disturb the limb. When this has taken place the bones are replaced in situ by means of extension, counter-extension, and coaptation or setting. Before resorting to extension, the limb should be placed in such a situation, if possible, as to relax the principal muscles, as our object is to avoid, as much as we possibly can, the resistance afforded by muscular contraction, which forms the principal impediment to our success. The extending force should now be applied to the lower part of the limb, avoiding the immediate seat of the fracture, and the limb drawn in the direction of the bone fractured, or as near this as the displacement of the fractured portion will admit of. The counter-extension, on the contrary, is applied above the fracture, and consists merely in passive resistance to extending power. The extension should be made cautiously and gradually, as otherwise the muscles will be thrown into spasmodic contraction, and may baffle all our attempts. When any difficulty is experienced from the violent contraction of the muscles, the abstraction of blood from the arm, or the administration of tartar emetic will assist our efforts much; it is seldom that these remedies are required.

As soon as the fractured portions are thus brought into apposition, they are to be placed in their natural position, and retained so by means of bandages, compresses, and splints.

Suppose, then, that we are treating a fracture of the centre of the femur in the extended position, and that coaptation has been effected. A mattress, or other resisting bed, is to be prepared, on which the patient is placed in the recumbent posture; indeed, it were better to place the patient on the bed previously to our having recourse to extension, and counter-extension, as thus any danger of disturbing the fractured portions when once they have been placed in apposition, by moving him from one bed to the other, is avoided. A many-tailed bandage being wet with cold evaporating lotion, such as the lotio muriatis ammoniæ, or the lotio acetatis plumbi, or cold water, is to be passed beneath the thigh, and then carefully applied round the limb from below upwards, the ends of each bandage overlapped in front, and the lower bandage overlapped by that immediately above; the highest bandage is, lastly, to be secured with pins. Compresses wet in the lotion are now to be applied so as to form a uniform surface for the pressure of the splints, and to protect the projecting eminences of the bones. The splints, one on either side, one in front, and one along the back of the limb if thought necessary, are now to be applied, and secured by means of tapes passed around the limb. The inner lateral splint should extend from the pudenda, the outer one from the crest of the ilium to a short distance below the foot, and be provided here with a foot-piece to which the foot is to be attached, so as to prevent the rotation of the leg, and the consequent displacement of the fracture. All parts of the splints likely to press on any portion of the limb or trunk should be covered with portions of bandage, or the pressure borne off by means of compresses.

Some prefer placing the limb on the double inclined plane with the knee flexed so as to form a nearly right angle with the thigh, on the grounds that, the muscles being relaxed, displacement of the bones is not so likely to take place. This position is objectionable, as we are unable to compare the relative length of the injured with the sound limb, which should always be done from time to time in the treatment of every fracture. When the fracture is oblique the flexed position is to be preferred, as the weight of the leg acts as a counter-extending force, and prevents the displacement of the fracture. Mr. Pott's plan of placing the limb on the outer side is now nearly, if not wholly, abandoned.

The after-treatment of fractures consists in the occasional opening of the bandages to ascertain the condition of the limb, and in applying such remedies as may be considered necessary. Should any of the bandages have become soiled, new ones may be substituted by attaching them to the ends of those about to be removed, and drawing them one by one gently beneath the limb. If inflammation have set in, leeches may be applied, and the antiphlogistic regimen adopted. The bandages and splints are to be replaced for a few days longer, and so on, until the fracture is found to have united. The period for the accomplishment varies according to the bones broken, the age and constitution of the patient. Thus the bones of the lower extremities in the healthy state seldom unite sooner than five or six weeks, whereas those of the upper extremity take but three or four weeks. The bones of the infant unite in a week or ten days, whilst those of the old subject take from six to eight weeks to become consolidated. When there is any disease of the constitution the union may be protracted to a much longer period. The patient remains in general from four to six weeks after the fracture has united before he recovers the use of the limb, in consequence of the effusion that has taken place into the limb, the stiffness of the articulations, and the weakness of the muscles. The use of liniments and bathing with cold water will be found to strengthen the part and expedite reunion. Where moderate attention has been paid, the surgeon meets with but little trouble in the treatment of simple fractures, nevertheless some unpleasant symptoms occasionally occur, viz.

First. *Inflammation* of the limb as first alluded to.

Secondly. *Threatening mortification.* This only takes place when the inflammatory symptoms have not met with attention, or when the bandages have been tied too tightly on the limb, or when this has become swollen after their application and the surgeon has disregarded or overlooked the circumstance. In such cases the bandages should be at once loosened, and soothing remedies applied to the limb, aided by the usual means resorted to for the prevention of gangrene.

Thirdly. *Sores forming on the limb;* these are produced by the pressure of a bandage or a splint, by the limb resting on a particular part, and are often exceedingly troublesome, degenerating into ill-conditioned ulcers, very difficult to heal. On their first appearance all pressure should be at once removed, and, if necessary, the position of the limb changed; the sores may be protected by the emplastrum saponis; greasy applications are not recommended, as they are liable to produce excoriations of the parts.

Fourthly. *Non-union.* This we shall treat of hereafter.

It is always a judicious plan to change the position of the limb at least once during the treatment of the simple fracture, so as to give relief to the patient and prevent anchylosis of the articulation, which will be still further prevented by gentle motion of the joint.

The *mode of union* in simple fracture is analogous to union by the first intention in the soft parts, and differs but little from the manner in which bone is originally formed. Immediately after the fracture has taken place a quantity of blood is poured out into the surrounding cellular tissue by the vessels of the bone, periosteum, and adjoining structures; inflammation now sets in, the periosteum becomes thickened, increased in vascularity, and is easily detached from the bone, the ends of the bone become rounded off, increased in size and vascularity, and become softened. By this time the blood originally effused is absorbed, and new lymph is poured out from the bone, periosteum, and surrounding soft parts around the fracture. This lymph becomes united with the ends of the bone, and thus acts as a bond of union between them. The lymph soon becomes organized, vessels are formed in it, which pour out the bony matter into its interstices, and thus ossification proceeds until complete union has taken place. Some assert that the fibrine of the blood first effused, and not lymph, is the nidus for the deposition of the ossific matter. We consider this to be incorrect, since, on examining a fracture that has been recently united, we find much thickening of the periosteum and surrounding soft parts, the bone is larger than natural, more rounded, and but indistinctly marked with the usual eminences and depressions, and its medullary canal is closed. After some time the canal is re-established, and the bone differs but little from its natural state. It should be carefully borne in mind that when inflammation of the limb has taken place, this should be removed by the application of leeches, cold lotions, and other means, before we resort to the use of splints and bandages: the limb should be placed during this treatment in the position easiest to the parts, and kept as quiet as possible. Having now laid down the great principles to be observed in the treatment of fractures, we proceed to the consideration of particular fractures.

Fractures of the ossa nasi are always caused by direct violence; the displacement may be trifling, or so great as to produce considerable deformity. *Treatment:* The bones are to be placed in situ by means of a female silver catheter, or other resisting instrument, passed into the nasal cavity, and supported by compresses of lint, or an elastic tube introduced into the nose. Some consider that these bodies are not required, and are productive of irritation, and therefore recommend the fracture to be healed without any artificial support. It occasionally happens that the crista galli of the ethmoid bone is driven upwards into the brain by the violence that has caused the fracture. It is possible that the crista galli may be drawn down by means of a forceps introduced into the nose.

Any symptoms of inflammation of the brain or its membranes should be actively treated.

Fractures of the lower jaw. This bone is always broken by direct violence. It may be fractured at the symphysis, or the body, or the ramus. Fracture at the *symphysis* is exceedingly rare. This bone is most frequently fractured in the body immediately in front of the insertion of the masseter muscle. The fracture is in general easily recognized by passing the fingers along the base of the jaw externally and the mouth internally. Crepitus may also be felt by moving the fractured portions one against the other. *Treatment:* The bone being placed in situ, a flat piece of cork is to be placed between the jaws of the affected side; a pasteboard splint, previously moistened in vinegar and water, is now to be moulded on the part externally, and retained by means of a bandage of four tails, the centre of which rests against the chin, while the tails are brought round the top and back of the head, and fastened to the patient's nightcap. All motion of the jaws is to be strictly prohibited. The displacement in the fracture is frequently occasioned by muscular contraction, the masseter muscle raising the angle whilst the digastric and other muscles depress the symphysis. The ramus of the jaw, being covered by the masseter, is rarely fractured. When broken here, this muscle acting as a splint prevents much displacement. It is treated as the foregoing. Fractures of the lower jaw, particularly where it has been broken in two places, are frequently followed by necrosis, and, where much violence has been used, by abscesses in the neck and fauces.

In fracture of the jaw, if any of the teeth be quite loose, it is better to extract them at once, but much caution is required in so doing.

Fractures of the vertebræ will be considered in treating of the spine.

Fracture of the sternum. This bone is fractured only by direct violence: but little can be done by local applications. A bandage passed round the chest, so as to moderate the action of the ribs, with a small compress directly in front of the bone may be found useful. The thoracic viscera in such injuries call for our best attention.

Fracture of the ribs. The middle and lower ribs are most frequently broken, being the most exposed, and supported posteriorly against the spine, and in front by the sternum. The first rib is protected by the clavicle, the last two escape fracture by their great elasticity, not being fixed in front. The ribs are in general fractured about their centre, near their greatest convexity. The fractured portions are displaced either internally or externally, which may be ascertained by passing the fingers along the rib from the spine forwards, and by the crepitus, which is frequently manifest in each act of respiration of the patient, or on coughing. These fractures are *treated* by placing a piece of soap-plaster over the parts, and then surrounding the chest with a bandage, so as to restrain, or at least moderate the action of the ribs, the patient being obliged to respire by the diaphragm. Fractures of the ribs are sometimes serious from a spicula of bone being pressed inwards and wounding the lung, thus giving rise to emphysema and inflammation of this organ, if not actively treated.

Fracture of the bones of the pelvis. These bones are occasionally fractured, and in general, by direct violence. The treatment consists in supporting the bones by means of compresses and bandages judiciously applied, and enjoining perfect rest at the same time.

Fracture of the femur. The femur may be fractured in any part of its extent, but is most frequently broken at its middle third or in its neck.

Fractures of the neck of the femur are divided into those which are internal to the capsular ligament, and those which are partly *within* partly *without* the ligament. There is no such thing as fracture of the neck of the femur completely beyond the capsular ligament, as the ligament extends anteriorly as far as the neck of the femur itself. The bone may be broken posteriorly external to (or *without*) the capsular ligament; but if the fracture extend anteriorly beyond the ligament it must pass through the trochanter major. Fractures of the neck of the femur are very frequent at the advanced period of life, in consequence of the anatomical changes which take place in it at this age; it is still more frequent in the female than in the male, as the neck of the femur is more transverse and longer than in the former.

The neck of the femur is in general fractured by falls on the trochanter major, or by the foot coming violently against the ground, or in slipping off the curb-stone in walking. The *symptoms* of the fracture are best observed when the patient is placed in the recumbent posture. The injured limb will then be found to be from one to two inches shorter than the other, having been retracted by the action of the gluteal muscles; the heel rests against the fossa between the internal malleolus and os calcis of the opposite foot; the foot is everted from the greater power of the rotators outwards and the natural inclination of the limb to this position; the patella is higher up than the opposite one, and the hip is less prominent than in the natural state. The patient is wholly unable to raise the limb from the bed. If the surgeon now places his hand on the trochanter, and extension be made by an assistant from the foot, and the limb rotated, as soon as it is brought to the same length with the other, so as to bring the fractured portions in contact, crepitus is at once distinguished. Rotation inwards and abduction are particularly painful. In rotating the femur the bone is observed to turn upon its own axis, the trochanter major not, as in its natural state, describing a semicircular motion. So soon as the extending force is removed, the limb is again retracted. In general, fracture of the neck of the femur is easy of diagnosis, but this is not always the case, as the bone may be fractured without presenting the symptoms mentioned; thus shortening is not always present, and in many cases does not occur for some days after the receipt of the injury, arising most probably from the bones being impacted one into the other, or some spiculæ retaining their hold; the foot may be inverted, but this is rare, or it may be in any position, in which it is accidentally placed; there is often too, great swelling about the joint, and effusion into the synovial sac, which obscure the appearances of the parts, and render crepitus indistinct.

Dislocation of the hip-joint on the dorsum of the ilium, or into the sciatic notch, and contusion of the soft parts about the articulation, are most likely to be mistaken for fracture of the neck of the femur.

The *treatment* of fracture of the neck of the femur consists in placing the limb on the double inclined plane, the knee being flexed, and keeping the part at rest. At the end of six weeks partial motion may be permitted, and at the expiration of the seventh or eighth week the patient may be allowed to get up, and walk on crutches with the limb supported by a sling.

Bony union does not take place in fractures of the neck of the femur within the capsular ligament; the union is ligamentous, and formed by bands of ligamentary structure passing from the fractured portions to the inner surface of the capsular ligament, aided by thickening of this ligament, and of the synovial membrane. The causes of the non-ossific union are found to be the advanced age of the patient,—the difficulty of keeping the bones in apposition, and the deficient vitality of the head of the bone, which, when the neck is fractured, is supplied with vessels through the ligamentum teres only. Fracture of the neck of the femur, partly without the capsular ligament, takes place in younger subjects, is caused by greater violence, and is attended with more pain; it is indicated by the greater shortening of the limb (Sir A. Cooper states the reverse, that given is the generally received opinion,) and the history of the case. Its treatment is similar to that for fractures without the capsule. Ossific union may take place.

Dessault, Boyer, and other surgeons have recommended various instruments for maintaining a state of permanent extension during the treatment of fractures of the neck of the femur: they are now seldom used, as the patient is generally unable to bear this operation for any length of time.

Fractures of the femur through the trochanter major are produced by direct violence. *Symptoms:* Pain, crepitus, loss of motion, and eversion of the foot. *Treatment:* Place the limb on the double inclined plane, and support the part with compresses, bandages, and splints.

Fracture of the femur in its upper third. Causes: Direct or indirect violence. *General Symptom:* The upper fractured portion is here drawn forwards by the action of the psoas magnus and iliacus internus muscles. *Treatment:* Place the limb on the double inclined plane, the patient nearly in the sitting posture, the hip-joint flexed, and the knee extended so as to relax the psoas and iliacus internus muscles; assist the position by means of compresses and splints judiciously applied.

Fracture of the middle third of the femur has been already treated of at page 161.

Fractures of the lower third of the femur are treated on the double inclined plane, with the knee-joint flexed to prevent the action of the heads of the gastrocnemius on the lower fractured portion.

Fractures of either condyle of the femur extending to the knee-joint are treated in the straight position in order that the upper surface of the tibia may act as a support to the fracture. A pasteboard splint, moulded on the joint, supported by common splints and bandages, should be made use of. Passive motion should be commenced at the end of the fifth week.

Fractures of the patella. The transverse fracture of the patella is the most frequent. It is generally produced by the spasmodic action of the rectus muscle, when the knee is in the semiflexed position, the patella being then broken across the lower end of the femur. The patella may be also fractured transversely by direct violence, as in falling on the knee. *Symptoms:* Pain and swelling about the joint, separation of the broken bones, the superior being drawn upwards by the rectus muscle, and inability of extending the limb. *Treatment:* Place the limb in the extended position, flexing the hip-joint so as to relax the rectus femoris, and allow of the upper portion being drawn down and placed in apposition with the lower. This being accomplished, a leather belt is buckled round the thigh above the upper portion of bone, from each side of which a leather strap provided with buckles passes to a broad belt beneath the foot, and is thus secured. By these means, aided by a splint along the dorsum of the limb, compresses, and bandages, if necessary, permanent extension is maintained for five weeks, after which period passive motion is to be resorted to. A transverse fracture of the patella unites generally, if not always, by ligaments; it should be our object to have this ligament as short as possible, as the future use of the limb is proportionate to its length.

Longitudinal fractures of the patella are caused by direct violence. They are treated by placing the limb in the extended position, passing a roller round the joint, and then buckling over this a laced knee-cap. This fracture unites by bone.

Fractures of the tibia in its upper two thirds are generally transverse. There is nothing peculiar in their history, symptoms, or treatment. The double inclined plane is the best instrument to use in their treatment.

Fracture of the lower third of the tibia. The tibia is most frequently broken in its lower third near the junction of this with the middle third, the bone being here smaller than elsewhere, more superficial, and unsupported by the bellies of the muscles. The fracture is almost always oblique, running downwards and inwards, and hence is frequently converted into a compound fracture from the patient attempting to stand or walk on the limb after the accident, and thus protruding the point of the upper portion of the bone through the skin. The fracture is at once recognized from the superficial coverings of the bone. The fibula is in general fractured at the same time. Fracture of the lower third of the tibia is best treated on the double inclined plane, with the leg in a slightly depending position, so as to relax the gastrocnemii muscles.

Fracture of the fibula. The fibula may be fractured in any part of its extent. In general it is broken about an inch and a half above the external malleolus. This is usually known by the name of Pott's fracture of the fibula, or Pott's dislocation of the ankle, being often accompanied by a partial dislocation of the lower extremity of the tibia inwards, or of the foot outwards. This fracture may be caused by direct violence, or by violent strains of the leg, as in wrestling, leaping, &c. On examining the limb some swelling will be found caused by effusion of blood into the cellular tissue, the foot is everted, that is, the inner margin is turned downwards whilst the outward margin is raised, the internal malleolus projects more than in the natural state in consequence of being partially dislocated inwards, so that its outer part rests on the inner margin of the astragalus. This deformity of the foot results from the obliquity of the upper surface of the astragalus, which sloping inwards favours the descent of the tibia in this direction aided by the spasmodic contraction of the peroneus longus muscle, which elevates the outer whilst it depresses the inner edge of the foot. Corresponding to the seat of fracture, a depression is in general observed, produced by the falling inwards of the fractured portion of the bone, the external malleolus being thrown outwards at the same time. On passing the fingers along the fibula the irregularity of the fracture is manifest. Crepitus is with difficulty distinguished in this fracture, from the lower portion being so firmly fixed by the ligaments of the ankle-joint. Extension and counter-extension having been made, so as to reduce the displacement of the tibia and place the fractured bones in apposition, the limb is to be laid on the outer side with the knee flexed, the foot at right angles with the leg, and the heel brought towards the opposite limb, the patient being placed on the side corresponding to the injured limb. Bandages and splints are to be applied, and the fracture treated as already laid down in discussing fractures generally. This was the plan of treatment recommended by Mr. Pott. Dupuytren has more recently advised the fracture to be treated by placing a splint on the inner side of the limb extending from above the knee to a short distance below the ankle; this is to be attached by means of bandages applied one above the other below the knee-joint, a long cushion being interposed between the leg and the splint; the foot is now to be twisted inwards and made fast in this position to the lower extremity of the splint. The object of this plan of treatment is, by putting the external lateral ligament on the stretch, to draw inwards the external malleolus, and force outwards the upper end of the lower fractured portion; for, if this be not attended to, the fibula will become consolidated with the tibia, and thus the mortice-shaped cavity between these bones rendered too wide for the astragalus; the joint is thus rendered loose and insecure, and the patient is constantly exposed to accidents of the articulation.

Fracture of the clavicle. This bone is frequently fractured in consequence of its being so much exposed, and having to support the weight of the shoulder and arm. It is most frequently fractured near its centre, where the bone is weakest, least supported by muscles, and suffers most from the two arches, of which the bone is composed, meeting here. The injury is produced by falls on the shoulder, or by direct violence; it is at once recognized by the projection of the fractured portions beneath the skin. The fracture is in general oblique, running downwards and inwards; it is always attended with much displacement, as the shoulder, falling inwards from wanting the support of the clavicle, drags the outer portion with it, which is thus overlapped by the inner or clavicular portion. The *treatment* of this fracture resolves itself into the raising of the shoulder, and with it the displaced portion of the clavicle to a level with the sternal portion, and retaining them so by means of artificial support. This is best effected by means of a pad placed in the axilla, and a bandage passing round the trunk and injured extremity in such a manner as to keep back the weight of the shoulder and support the arm. The bandage, from its crossing in front and behind the patient, is named the figure-of-eight bandage. Different instruments have been recommended for the treatment of this fracture, but all act on the same principle as the bandage. That recommended by Sir A. Cooper is perhaps the best.

The *acromial* end of the clavicle, when fractured, presents little deformity from this portion of the bone being confined by ligaments.

Fractures of the scapula are extremely rare. The neck of the bone is sometimes broken in falls on the shoulder. In this accident the arm droops, and presents many of the characters of dislocation of the humerus into the axilla; it is distinguished from the latter by the crepitus recognized on placing the fingers on the coracoid process, and at the same time moving the arm; by the deformity being removed on pressing the arm upwards, and its immediate return on withdrawing the pressure. This fracture is treated as fractures of the clavicle, and the principal objects we have in view are the support and quietude of the arm. The English surgeons disapprove of the pad in the axilla, while the French recommend it. The union is generally by ligament. The fracture traverses the scapula behind the coracoid process. The acromion process is sometimes broken by falls on the shoulder; it is treated as the preceding, and unites also generally by ligament. The scapula itself may be broken, but this is exceedingly rare.

Fractures of the humerus. The humerus may be broken in any portion of its extent. Fracture of the upper third is generally described as fracture of the neck of the bone. The displacement attending this fracture varies as the bone is fractured above or below the insertion of the pectoralis major and latissimus dorsi muscles. In the former case, the lower portion of the bone is drawn inwards by these muscles, in the latter it is drawn outwards and upwards by the deltoid, whilst the upper portion is drawn inwards by the pectoralis and latissimus dorsi. This fracture may be mistaken for a dislocation of the humerus into the axilla, from which it may be distinguished by the shortening of the arm, and the crepitus ascertained by passing one hand over the shoulder, and fixing the head of the bone, and moving with the other the lower extremity of the humerus. This fracture is treated by passing a roller round the limb, the bones having been placed in apposition, and the applying of a splint on the anterior, posterior, and outer surfaces of the arm. There is no occasion for a splint on the inner side, as when the arm is brought inwards to the chest it will be sufficiently supported in this direction. It is well, however, to place a large flat compress inside the arm, so as to support the fracture in this direction. A very useful splint for treating fractures of the humerus, as well as many other fractures, is made by covering one surface of the splint with adhesive plaster, and then slitting the wood at intervals of about half an inch; the splint may then be bent so as to mould itself to the arm. When the splint has been applied the arm should be bandaged to the side, and the forearm be carefully supported in a sling.

Fracture of the humerus a little above the condyles is attended with a displacement such as to give rise to the appearance of a dislocation of the elbow-joint. Thus the triceps muscle, drawing upwards the olecranon process, throws forward the fracture so as to form an angle salient anteriorly. It may be distinguished from a dislocation, by the crepitus, the facility of removing the deformity by extension, which returns immediately on the extending force being removed, and by the relative position of the condyles and olecranon process, these being altered from their natural condition.

Fracture of the olecranon. This process is occasionally broken by falls or direct violence applied to it. The broken portion is drawn upwards by the triceps; an interval is formed between it and the remaining portion of the bone, which is easily ascertained by the fingers. The fracture is to be treated by keeping the limb in the extended position, and bringing down the detached portion of bone in apposition, if possible, with the shaft of the ulna, by means of compresses, splints, and bandages. The splint is placed along the anterior surface of the arm and forearm. This fracture unites by ligament. The coronoid process of the ulna is sometimes broken. This fracture is attended generally with partial dislocations of the ulna backwards; it is treated by keeping the arm in the flexed position.

Fractures of the ulna. The ulna is seldom fractured except by direct violence; there is little displacement attending the fracture, as the bone is supported by the radius, and no difficulty in detecting it from the bone being very superficial; it is treated with a roller applied round the forearm, splints, and a sling to support the arm.

Fractures of the radius. This bone is most frequently broken at a short distance above the wrist-joint, a fracture which is often mistaken for a dislocation of the articulation. The fracture occurs in advanced age, and is caused by a fall on the heel of the hand, in which the whole weight is thrown on the radius, in consequence of its articulation with the carpal bones; the result is a fracture of the radius in its lower expanded portion, from half an inch to an inch and a half above the styloid process. The accident is known by the history of the case; a swelling in front, produced by effusion into the sheaths of the tendons; a less extensive swelling at the dorsum of the wrist; a depression corresponding to the seat of the fracture, and caused by the pronator quadratus drawing in the fractured portion towards the ulna; and by the position of the hand, which is thrown backwards. Crepitus is with difficulty distinguished in this fracture from the lower extremity of the radius being fixed by ligaments: it is best ascertained by grasping the bone firmly above and below the seat of the fracture, and then moving the bones one on the other. Rotation of the hand is not sufficient for this purpose, as, from the broad surfaces by which the ends of the bone are in apposition, the whole radius will move as freely as when not broken. The bones having been placed in apposition by extension and counter-extension, a wetted roller is to be applied loosely round the forearm, a long narrow compress is to be now placed on the anterior, and another on the posterior surface of the forearm, and then compressed into the interosseous spaces, by means of splints extending along the front and back of the forearm, and reaching from the elbow to the palm of the hand, and made fast by a few turns of the bandage. The forearm is to be supported in a sling, the ulna supporting the weight of the extremity, and the hand allowed to hang. The great object in treating this fracture is to prevent the fractured portions of the radius from being drawn inwards by the pronator quadratus, thus obliterating the interosseous space. The patient seldom recovers the use of the hand before three or even six months, as the inflammation consequent on the fracture causes much swelling which is slowly removed.

Fractures of the metarcarpal bones take place by direct violence; they are treated by placing a ball within the clenched hand, and then applying a bandage.

Fractures of the phalanges of the fingers are treated by rolling the parts in a tape, or narrow calico bandage, and then applying a pasteboard splint.

COMPOUND FRACTURES

Are those in which one or more bones are broken, and the fracture communicates with the external air by means of a wound in the soft parts. The treatment of a compound fracture consists in placing the broken bones in apposition, and healing the external wound by the first intention, so as to convert the *compound* into a *simple* fracture. This is best accomplished by bringing the edges of the wound together with adhesive plaster, and with sutures if necessary. Sir A. Cooper recommends the part to be then covered with a portion of lint wet in the blood of the patient. It is not often that the surgeon is able to accomplish this desirable object, as the soft parts are in general so injured by the violence that produced the fracture, that they do not admit of being united by the first intention; the bone, too, may protrude, and thus prevent the accomplishment of our object.

As the lower end of the tibia, from its superficial position and the obliquity of its fracture, is more frequently the seat of a compound fracture, we shall select it to lay down the principles which should guide us in the treatment of this fracture. Let us say then that from some external violence the tibia is fractured in its lower third, and that the upper portion of the bone, which is almost universally the case, protrudes. The soft parts are in general covered with blood, and it may be with dirt, and present a dark livid appearance caused by the injury, and the effusion of blood beneath the skin. If possible, the bone should be at once returned by extension, and counter-extension; but this cannot always be effected, as it is frequently so confined by the skin as to prevent its reduction; the wound should now be dilated where the constriction on the bone is greatest, that it may be reduced. If the bone cannot now be returned, the protruding end should be sawn off, and the wound closed. If any portions of bone are loose and detached, they should be at once removed. The limb is now to be placed in the most convenient position, and all inflammatory symptoms treated by the antiphlogistic regimen. If the case should prove favorable, moderate inflammation of the wound takes place, followed by suppuration; at the end of the third or fourth day, granulations are formed by the bone and soft parts, which coalescing close the external wound, and afterwards consolidate the fracture, the ossific matter being deposited in the granulations which proceed from the bone and periosteum. Compound fractures are seldom healed until the tenth or twelfth week after the receipt of the injury. During this time the wound should be dressed daily, or every second or third day, according to the quantity of discharge, and fresh dressings be applied, supported by means of bandages which press moderately on the parts. Hence the advantages of the many-tailed bandages over the roller are apparent, as they may be removed with facility without any disturbance of the parts.

It is very seldom that a compound fracture proceeds to its termination without troublesome or dangerous symptoms. The principal of these are spasmodic twitchings, violent inflammation, and secondary hemorrhage.

Spasmodic twitchings of the muscles displace the bones, and cause much distress to the patient. These are best treated by placing the limb in that position which relaxes the principal muscles, by the use of cold lotions to the parts, and by the exhibition of opium and other anodynes.

Violent inflammation of the parts. This commences generally towards the end of the first twenty-four hours after the receipt of the injury, and should be at once combated by the antiphlogistic regimen, as a preventive measure, for the result is likely to be either profuse suppuration or mortification. General bloodletting should be had recourse to but sparingly, as otherwise we debilitate our patient too much, and thus disable him from bearing up against the future calls on his constitution. Leeches and fomentations should be applied about the wound, and this be enveloped in a common poultice, or the modern treatment by water-dressings may be resorted to. The bowels should be opened by enemata, and the use of these followed by the exhibition of diaphoretic medicines. When profuse suppuration ensues, the lodgement of matter should be prevented by the wound being placed, if possible, in a dependent position, by the use of compresses, and, if necessary, by making a counter-opening. The suppuration may be caused by foreign bodies, or a loose spicula of bone lodged in the wound, or by the too long continued use of poultices and fomentations. If the former be present, they should be removed, the latter should be at once discontinued, and simple or astringent dressing applied, the patient's constitution being supported by the exhibition of bark and a generous diet. Mortification appears on the third or fourth day. If partial, the sloughs separate, and the wound heals by granulation. Should it extend, so as to threaten the life of the patient, amputation is to be performed, if not contra-indicated by the state of the sufferer. The limb should be removed at some distance from the extensively mortified parts, as the gangrene extends further in the soft parts, and particularly in the cellular tissue beneath the integuments, than in the skin. If possible, a joint should intervene. Such amputations rarely succeed. If the gangrene appear to have been the result of a debilitated constitution, not of the local injury, amputation should not be performed.

Secondary hemorrhage. This proceeds from sloughing of some of the arteries of the limb, and generally requires amputation. When it proceeds from this cause, it does not appear for some days after the accident. Bleeding, however, may take place immediately on the receipt of the injury, from laceration of the vessels.

Many cases of compound fracture present themselves, which call for immediate or primary amputation. These are, first, where the bones are much comminuted, and the affected parts are at the same time extensively destroyed. Secondly, when the principal vessels and nerves of the limb are injured. Thirdly, when the age and constitution of the patient lead us to suppose that he may be unable to support the difficulties attending the union of the fracture.

Comminuted fractures are those in which the bones are broken into several portions. Their *treatment* and terminations depend on their being simple or compound. We need not, therefore, discuss them particularly. *Complicated fractures* are those which are complicated with some other injury, as a wound of the principal artery of the limb, or an extension of the fracture into a joint. When the principal artery has been wounded, the limb becomes swollen immediately after the receipt of the injury; and if the blood be effused immediately beneath the skin, this presents a dark, livid appearance (ecchymosis), which should not be mistaken for gangrene; the limb becomes cold, and the patient complains of much pain and tension of the parts. Some surgeons recommend the tying of the principal arteries leading to the limb, as the popliteal, where the tibial arteries are wounded; others prefer amputation. This point is not as yet settled in surgery. If the parts be left to nature, mortification ensues, or the integuments inflame and give way, the coagulated blood mixed with bubbles of gas and a fetid discharge escape, and are soon followed by the fluid blood. When the wounded artery is not large, and the quantity of blood effused but small, this becomes absorbed, and the fracture heals without any bad symptom. On no account should we cut down on the wounded vessel, as by so doing we convert a simple into a compound fracture.

Bones are sometimes partially fractured and bent in children; the *treatment* is the same as that recommended for simple fracture, sufficient pressure being made to remove any deformity that may exist.

Fractures of cartilage unite by bone; those of fibrocartilage by ligament.

Generally speaking, the extension of a simple fracture into a joint does not interfere with the ultimate success of the case. Some inflammation of the joint may ensue, but can be removed by leeches, cold lotions, &c.

ON NON-UNION OF FRACTURES.

It sometimes happens, that on examining a fracture at the end of the period at which we should expect union to be complete, we find no attempt at the union of the bones has taken place. This non-union may arise from several causes.

1st. *From deficient inflammatory action.* When, in the treatment of a fracture, it is found that there is no pain in the part, and no constitutional disturbance, it is necessary to excite such by moving the fracture moderately, by tightening the bandages, or by placing the patient on a full generous diet, as a certain degree of inflammation is indispensable to the healing of the fracture.

2d. *From a diseased or peculiar state of the constitution.* Persons of a scrofulous or otherwise weak state of the constitution are most liable to non-union of a fracture. In these a generous diet and good air will be found beneficial. Where there is a syphilitic taint in the constitution, a fracture will often not unite. Mercury should be given, when union will in general take place. The exhibition of mercury will often cause a fracture to unite, even where no syphilis is present. It has been stated, that fractures do not unite in pregnant women: such is not the case.

3d. *Where the limb has not been kept at rest.* This frequently is the cause of non-union. The limb being repeatedly moved during the first few weeks, the disposition to union has been lost, and is with difficulty reproduced. If proper means be not resorted to, a false joint will form in the limb, in which the ends of the bones become rounded, covered with a hard deposit, and inclosed by ligaments. Before such false joint has formed, we should, by moving the fracture, break up any ligamentary adhesions that exist, and reproduce the inflammatory action; by which, and the subsequent use of tight bandages and splints, union may at length be accomplished. Should this not succeed, a seton should be passed between the broken ends of the bones, and allowed to remain for a few days, or until sufficient inflammation has been excited, when it is to be withdrawn. It has been recommended also to cut down on the fracture, and saw off the ends of the bones. This is very questionable practice, as a compound fracture is formed, which may be followed by dangerous if not fatal consequences. Amputation has been occasionally practised, but few cases will be met with in which it is called for. The humerus is more frequently the subject of non-union than any other bone. Non-union occasionally follows a compound fracture; here there can be no serious objection to the sawing off the ends of the bones, as a compound fracture already exists: before doing so a strict examination should be made of the limb, as a spicula of bone, some foreign body, or a collection of matter, may be the cause of non-union, on the removal of which the bones will unite.

DISEASES OF BONES.

Phlegmonous inflammation, commencing in the bone itself, is of rare occurrence. More frequently the inflammation first attacks the periosteum, and spreads from thence to the osseous tissue. The symptoms are usually of a local character: they are a deep, heavy, though sometimes acute pain in the bone, followed soon by an enlargement of the osseous structure, and thickening of the periosteum. The inflammation may either terminate in ulceration of the bone (caries), or in the formation of an abscess in its interior, but more frequently ends in necrosis.

Necrosis is complete death of a bone, attended with or followed by the formation of new bone. It is analogous to mortification in the soft parts. Necrosis usually affects the shafts of the long bones, from their being composed of compact tissue, and less highly organized than the spongy bones. The tibia, femur, lower jaw, clavicle, humerus, fibula, radius, and ulna, are the bones most frequently affected. Although no age is wholly exempt from necrosis, it more frequently appears in youth before or about puberty, with the exception of the necrosis of the lower jaw, which in general appears in adult or advanced life. Next to the long, the flat bones are most liable to necrosis; and, last of all, the irregular bones. As necrosis most frequently attacks the tibia, we shall select a case of this nature to illustrate the disease. Necrosis of the tibia may be caused either by direct violence, as by blows on the part, by exposure to cold, or may appear without any evident cause. The first appearance, or first stage, is a dull, heavy, and constant pain in the bone, without any redness of the skin. By degrees the limb begins to swell, as the inflammation spreads to the more superficial parts, the periosteum becomes thicker, and the integuments inflame, either through the whole length of the bone or in detached portions. There is, in general, some slight constitutional fever at this time. As the disease advances to its second stage, abscesses form, and burst externally at different points. The matter discharged is in general healthy, but may be thin and fetid, and cannot be increased in quantity by pressure, as it collects in the interior of the bone. The openings of the abscesses are small, circular, and furnished each with a fungous papilla of a red colour, which obscures the apertures from view. Through those openings the dead bone, or sequestrum, begins soon to protrude (third stage), in pieces of variable size, sometimes large, but more frequently small and numerous, and are ultimately thrown off or removed by the surgeon. The detached portions of bone are exceedingly rough and irregular, their extremities present a worm-eaten appearance, and their surfaces appear as if acted on by the absorbent vessels. That portion of them which is lodged in the limb is of a white colour, but that exposed to the air generally becomes discoloured, sometimes black. Whilst by these means the old bone is being separated from the system, a new bone is in progress of formation, and is often completed before the old bone, or sequestrum, is thrown off, so that the patient may not be deprived of the use of the limb at any period of the complaint. The new bone is formed around, so as to inclose the old bone; which, in process of time, makes its way through the new bone, and is thrown off as already described. It has been much disputed, whether the new bone is formed by the old periosteum, by the remaining ends of the old bone, or by a new periosteum formed from the adjacent cellular tissue. There can be no doubt that each of these agents conduces to the formation of the new bone; and that, should the old periosteum perish with the bone, nature possesses the power to form a new one, and thus produce the new bone.

The progress of necrosis is in general exceedingly slow, so as to deserve the name of a chronic disease, years sometimes elapsing before recovery is completed; there is, however, an acute form of the disease, which moves more rapidly to its termination, and sometimes causes the death of the patient. In this the local inflammation is great, and is accompanied by a corresponding degree of constitutional disturbance, the patient being confined to bed, and incapable of making any use of the limb. The use of leeches, fomentations, and cataplasms, will be found beneficial in relieving the patient's sufferings.

When the disease is extremely acute, and the patient begins to sink beneath the pain and discharge from the limb, and the consequent irritation of the constitution, amputation frequently becomes necessary. In the chronic form of necrosis, the surgeon has little to do. If, indeed, the sequestrum be tedious in separating, perforation may be made through the new bone, so as to remove the portions of the old which still remain, but this operation is seldom required. If the limb be examined some time after the cure is completed, the new bone will be found to be larger and more circular than the old, and not so distinctly marked with the eminences and depressions for the attachment and course of the muscles and tendons. In other respects there is no difference. The term necrosis is usually applied, although not correctly, to the partial exfoliation of the bones of the cranium.

Scrofulous inflammation of bone. This disease is nearly confined to the spongy tissue of bones; thus the vertebræ, the heads of the long bones, where they form articulations, and particularly the larger joints, as the hip and knee, the carpal and tarsal bones, are most frequently affected with it. The disease is most common in the young subject before puberty, and in persons of a scrofulous diathesis.

Scrofulous disease of the vertebræ. This is generally known as caries of the vertebræ, or Pott's disease of the spine. This affection appears much more frequently in the dorsal than in the lumbar or cervical region. It sometimes appears spontaneously, at other times as the result of injury, as a fall or blow on the spinal region. If the patient be a child, the account most frequently given is that at first it had been observed to be languid, listless, and easily tired; and frequently to trip and stumble, although no impediment lay in its way; that when it moved hastily or unguardedly, its legs would cross each other involuntarily, by which it was often and suddenly thrown down; that if it endeavoured to stand without support, its knees would totter and bend under it; that it could not with any degree of precision or certainty steadily direct either of its feet to any particular point; but that, in attempting so to do, they would be suddenly and involuntarily brought across each other; that soon after this it complained of frequent pains and twitchings in its thighs, particularly when in bed, and of an uneasy sensation or tightness across the epigastrium; that when it sat it endeavoured to support the head artificially; the legs were almost always found across each other, and drawn up under the seat, and that soon after it entirely lost the power of walking. There is usually also present a dull, heavy pain, and weakness in the region affected; and the digestive and respiratory organs are incapable of discharging their functions perfectly.

If the patient be placed on the face, and the spine examined by striking with a moderate degree of force each spinous process; or, what is better, by moving each from side to side he will instantly wince, when the diseased part is handled, and at the same time complains of pains shooting in the course of the spinal marrow and principal nerves. This, which may be considered as the first or inflammatory stage of the disease, is characterized at a somewhat later period by a peculiar state of the limbs, termed palsy, and induced by the inflammation having spread to the spinal marrow and membranes; in this the muscles are rigid, and almost always in a tonic state, by which the knees and ankles acquire a stiffness not easily overcome. By means of this stiffness, mixed with a kind of spasm, the legs of the patient are either constantly kept stretched out, in which case considerable force is required to bend them, or they are drawn across each other, so as to be with difficulty separated. When the limbs are forcibly bent, the legs are suddenly drawn up with the heels towards the buttocks. The feet are forcibly extended, so that the patient cannot put the heels to the ground. There may be also at this time retention of urine, and, if the subject be a male, shooting pains along the spermatic chord, with occasional retraction of the testes.

It is in this, the early stage of the disease, that *treatment* will be found most effectual in arresting the progress of the disease. For this purpose strict rest in the horizontal position should be enjoined, at the same time that the patient should have the advantage of good air and diet. The state of the stomach and bowels should be also attended to. Leeches should be applied in the neighbourhood of the diseased vertebræ, and after their application an issue inserted on one side at least of the spine, the other side being retained for the occasional application of blisters and leeches if necessary.

If the disease be not arrested in the first, it proceeds to the *second stage*. This is characterized by a curvature of the spine and the formation of an abscess. The curvature of the spine ensues from the destruction of the bodies of the vertebræ, when the spine bends beneath the weight of the head and upper extremities. The curve is always concave forwards and convex backwards, except in a few cases, where but one side of the bodies of the vertebræ is removed, when a lateral curve is formed. The extent of the curve varies according to the number of vertebræ affected; thus, if but one or two be removed, it will be angular, but if several, it will be much more extensive. The limbs now generally become paralyzed, having lost the tonic condition described as existing in the first stage, and remaining flaccid in any position in which they may be placed. This condition is produced by pressure on the spinal marrow, occasioned either by the displaced bones or by an effusion into the spinal canal; or it may be caused by a diseased state of the spinal marrow, the result of the inflammatory action.

The abscess which forms in this disease, collects in its immediate neighbourhood, but may present itself at some distant point. The usual course described is in the sheath of the psoas muscle, which conducts it beneath Poupart's ligament into the upper and inner part of the thigh, hence called psoas abscess. The matter may point in other regions, as, for example, in the dorsal and lumbar regions posteriorly, by the side of the rectum or under the gluteus maximus muscle, having made its way outwards through the sciatic notch. The course of the abscess is much influenced by the usual position of the patient; thus, if he have been confined to bed, it will most likely point on the posterior surface of the body; but if he have been walking about it will descend. These abscesses have been frequently confounded with other diseases, such as aneurism, hernia, and fistula in ano. The sense of fluctuation and the history of the case will in general serve to distinguish them. The plan of *treatment* in the second stage differs but little from that recommended for the first, with the exception that leeches may be dispensed with. The abscesses are best left to nature, unless when they are productive of much uneasiness, local or constitutional. Mr. Abernethy has recommended their being opened frequently, and their contents given exit to, by which means the cyst of the abscess may be made to contract, and thus become obliterated. His plan is as follows: Select a part of the tumour which is free from inflammation, or any large blood-vessel, and not the most depending, through this introduce an abscess lancet obliquely into the abscess; allow the matter to flow off, taking care that no air enters; having nearly or wholly emptied the cyst, close the lips of the wound with adhesive plaster, that it may unite by the first intention, and apply a bandage and compresses over the cyst, so as to make pressure on it, and retard its future increase. By repeating the operation twice or thrice, it is hoped that a cure will be effected, as already mentioned.

This plan has been found not to succeed: in some the external wound has not healed, and the matter has continued to be discharged until the patient has sunk under the disease; in others the wound, although closed, has opened anew, producing the same result; whilst in many, inflammation has attacked the cyst of the abscess, and caused a fatal termination by the severe local and constitutional disturbances thus excited. In the latter case the patient is attacked with shiverings a few hours after the operation, the integuments covering the cyst become red, tender to the touch, a thin sanious matter, mixed with bubbles of air and clots of blood, is discharged from the abscess, delirium sets in, and the patient dies. This plan of treating chronic abscess should be confined to those cases which are not complicated with diseased bone.

The third stage of Pott's disease is that in which the abscess has burst or has been opened, and a well-marked hectic fever sets in, which soon brings on the fatal catastrophe. Patients labouring under disease of the spine sometimes die from inflammation of one of the large serous membranes.* When caries of the vertebræ affects the cervical or lumbar regions, there will be some modification of the disease dependent on the difference in the relative anatomy of the parts and the regions supplied with nerves from the spinal marrow.

A cure is sometimes effected in caries of the spine, more frequently in the first than in the second, and in this oftener than in the third stage. It takes place by the ulcerative process ceasing, when anchylosis of the bodies of the vertebræ ensues.

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* It is a remarkable circumstance that a large accumulation of matter will sometimes take place in the disease without inducing any severe constitutional affection.

In this case, ossific matter is thrown out along the sides and front of the spine in the affected region, which ties together the remains of the diseased vertebræ, and serves as buttresses for the support of the spinal column. This provision is still further strengthened by a condensation of the ligaments of the spine. The spinal marrow is preserved in its functions by an enlargement of the spinal canal. Caries of the vertebræ sometimes commences in the intervertebral substance, whence it extends to the spongy tissue of the bones. The disease has been also induced by inflammation attacking the psoas muscle, and thence extending to the spine. The intervertebral substance is removed equally with the bodies of the vertebræ.

Scrofulous disease of the ends of the bones will be more properly considered under the head of diseases of the joints. A caries of the long or flat bones sometimes occurs, as in the bones of the head, the tibia, &c. This is usually limited to the outer table of the bone, and presents an ulcerated surface, at the bottom of which is the diseased bone. The exfoliation of the diseased part should be expedited as much as is consistent with the safety of the patient; when this has been accomplished, the granulations from the healthy portions of the bone unite with those of the soft parts, and the ulcer heals.

Malignant diseases of bone. Although the osseous system is more frequently affected by the spread of malignant diseases to it from the neighbouring parts, still it is liable to a primary cancerous affection: this is usually called osteo-sarcoma. This disease is most frequently met with in the bones of the face, particularly the inferior maxilla, the long bones, and the ossa innominata. It commences with a deeply-seated pain in the bone, which after some time becomes enlarged, forming a distinct tumour or swelling: this is hard and affected with lancinating pains. By degrees the soft parts become inflamed, and at length giving way, a fungus issues from the diseased mass, as in cancer of the soft parts. As soon as the disease has been ascertained, it should be removed. This may be done by extirpation of the diseased bone, or amputation of the limb. The tumour is found to be composed in some cases of a homogeneous grayish, yellowish, lard-like substance; in others spiculæ of bone are met with; and in many, cells or cysts containing a medullary-looking substance, clots of blood, &c.

Exostosis is a term which implies a morbid growth from a bone, and is usually understood to be of an osseous nature. It is also improperly applied to other diseases of bones, some of which have been before alluded to. Of real exostosis there are three varieties, viz., solid, hollow, and foliated. The solid species includes a node, and also other projections, which attain a greater elevation above the surface of the bone. This is most common in the lower jaw, tibia, and femur, and occurs at or after the adult age. Excision is sometimes necessary for its removal, and the use of dilute phosphoric acid administered internally has been recommended, under the impression that it would dissolve the phosphate of lime, the largest constituent of the morbid growth. The other two varieties are connected with formation of soft matter, and are most frequently observed on the extremities.

Rachitis or *Rickets.* This term is applied to a diseased state of the bones, in which there is a deficiency of earthy matter, and they are consequently soft, yielding, and non-resisting: this condition is attended with an unhealthy state of the constitution, evidenced by the countenance, general emaciation, and tumid abdomen. The bones yield to the weight and pressure of the body, and there is considerable distortion. After some years this condition is altered, and the bones become hard and compact, but still retaining their early form. The treatment must be directed towards improving the general health, as by light nutritious diet and wholesome air. The limbs should not be called upon for over-exertion, and as the disease shows itself in children, they should be encouraged rather to crawl along than endeavour to get about by exercise in the erect posture. The preparations of iron seem to improve the assimilative functions, and are thus found often useful.

Mollities ossium, named also *Malacosteon*, is a morbid softening of the bones produced by absorption of earthy matter, and indeed of the natural animal substance of the bone. It occurs more frequently in females of the middle age, and, unlike the former, is attended with considerable pain. Medicines have little influence over it; they can palliate and assist dietetic remedies, but still the patient generally progresses to a premature death.

Fragilitas ossium is a term applied to the state of bones, in which, from slight exertion, they give way and break. This is ordinarily referred to a superabundance of earthy matter, but as often proceeds from excessive softening, or from osteo-sarcomatous disease. The bones have been remarked for yielding readily after the system has been long disturbed by carcinomatous disease. The constitution is ordinarily too much impaired for any benefit to be derived from the use of medicine.

DISEASES OF JOINTS.

The principal diseases of joints are *inflammation of the synovial membrane* or *synovitis*, *inflammation* or *ulceration of the cartilages*, *scrofulous diseases of the ends of the bone* or *white swelling*, and *rheumatic affections.* In addition to these, morbid growths frequently form in the joints, and necrosis may extend to the articular extremity of the bones.

As the knee-joint is that which is most frequently diseased, we shall select this as the standard for the rest, only noticing in them such peculiarities as deserve distinct consideration.

Inflammation of the synovial membrane or *synovitis.* This is brought on by wounds or injuries of the articulation, by exposure to cold, and by metastasis from the other joints. The disease is characterized by a severe pain soon diffused over the joint, which is followed in a few hours by considerable swelling caused by an effusion of serum into the articulation, which raises the patella from off the condyles of the femur, and extends some distance upwards on the anterior surface of the bone beneath the extensor tendons, and at the same time causes a projection on either side of the ligamentum patellæ. The temperature of the joint is much increased, but there is no redness of the integuments for some time after the commencement of the inflammation. There is severe constitutional fever, and the patient is unable to use the joint, all the structures in the articulation being affected.

If the disease be neglected, matter soon forms in the interior of the joint, which gradually makes its way outwards, and is discharged by one or more openings round the articulation, in general opposite the inner part of the head of the tibia. Hectic fever now sets in, and the patient is carried off unless amputation be performed.

The duration of the disease is extremely variable; in some cases it runs its course in two or three weeks, whilst in others it assumes a more chronic form, and may last for months or even years. In these latter cases a fatal termination is often superseded by an anchylosed condition of the joint, produced either by a condensation of the ligaments of the articulation, or by an ossific union of the bones.

The treatment of synovitis consists in the free application of leeches to the joint, cupping in its immediate neighbourhood followed by frequent fomentations. If these remedies, conjoined with a proper attention to the constitutional symptoms, do not relieve the affection, mercury should be exhibited, and, if necessary, to salivation. In the more chronic form, issues, setons, blisters, and the moxa applied around the joint will be found beneficial.

Ulceration of the cartilages takes place in more advanced life, and is characterized by a severe fixed pain referred to one part of the joint, most frequently on the inner side; this after some time, in many cases not for months, is followed by swelling of the joint, a diffusion of pain, and severe constitutional disturbance. It terminates, like synovitis, in the formation of matter in the articulation, and destruction of the interior of the joint.

Its treatment is the same as that recommended for synovitis. In some cases the ulceration of the cartilage ceases and the joint recovers, the place of the cartilage being supplied by an osseous deposition of an unusual hardness; in others anchylosis takes place.

Scrofulous affection of the knee-joint (*white swelling*). This affection appears either before or about the age of puberty, and in persons of a scrofulous diathesis. It is in general caused by repeated, though trifling, injuries, such as sprains of the joints, from which the patient recovers but imperfectly, leaving more or less weakness and sometimes pain in the articulation. By degrees the disease becomes established; the patient is now either confined to bed, or prevented from making any use of the limb. The joint when examined is found to be much swollen, the integuments are of a pale, white colour, and a number of bluish veins ramify over the joint. The pain in the articulation is seldom severe, often altogether absent, and the increase in temperature is not remarkable. The limb above and below the knee is much wasted, and the general health is impaired, but not seriously. In this stage particular attention should be paid to the state of the stomach and bowels, the patient being allowed a generous diet and a free use of good air. Counter-irritants and leeches should be applied to the joint, and splints placed behind it, so as to prevent all motion. As the disease advances, matter of a scrofulous nature forms in the interior of the articulation, and gradually makes its way outwards by several openings. The constitution now sympathises much, hectic fever sets in, and the patient is frequently carried off unless amputation be performed.

Whatever the primary affection may have been, the same appearances present themselves in a post-mortem examination of the articulation, when the disease has advanced to its last stage. Thus the cartilages are more or less removed, and particularly the inter-articular and the cartilage covering the head of the tibia; the synovial membrane is thickened, soft, and pulpy, the ligaments are removed, or degenerated into a soft pulpy mass, and the extremities of the bones are increased in vascularity. In the purely scrofulous affection a quantity of adipose substance is often met with beneath the skin, the cellular substance is filled with serum, the cartilages appear thinned and as if easily detached from the bones, and the spongy tissue of these is filled with a reddish watery fluid, and not unfrequently purulent matter. The sinuses around the joint, which have given exit to the matter, are lined by an adventitious membrane.

Sir B. Brodie has described a peculiar affection of the synovial membrane, in which it is converted into a pulpy brownish mass. The disease is not recognized as a distinct affection.

The applications most useful as counter-irritants, in chronic diseases of the knee, are the tartar-emetic ointment, the linimentum opii, the compound iodine ointment, and a liniment made with strong sulphuric acid and olive oil.

Diseases of the hip-joint. Synovitis of this articulation is much less frequently met with than in the knee, in consequence of being better covered with soft parts. It is in general caused by mechanical injury; when of the acute form it is less under control than synovitis of the knee. Sir B. Brodie relates a case in which matter was formed in the joint on the third day, and which proved fatal on the seventh day after the injury. The disease is characterized by acute deep-seated pain referred to the articulation, and increased on motion, general swelling around the hip, and severe constitutional disturbance.

Morbus coxæ. This is a scrofulous affection of the hip-joint, and therefore analogous to white swelling in the knee.

Its peculiar characteristic marks are best examined by dividing the disease into three stages.

First stage. Pain in the hip or knee-joint, or both, attended with sharp pains down the thigh, an inability to use the limb, an apparent elongation when the patient is placed in the erect posture, produced by the obliquity of the pelvis, which is itself caused by the patient resting only on the sound limb, and thus forcing the pelvis on that side upwards; eversion and pointing of the foot which is advanced in front of the other, curvature of the lumbar portion of the spine, the convexity towards the diseased side; fulness of the nates, soon followed by flattening and elongation, which causes the fold to be lower than on the opposite side; swelling in the inguinal region; severe pain in the hip, when the foot or knee is forced upwards.

Second stage. Shortening of the limb caused by absorption of the head of the femur, widening of the acetabulum, and finally by a dislocation of the femur on the dorsum of the ilium; formation of abscesses around the joint.

Third stage. Abscesses burst; there are sinuous openings around the articulation, most frequently behind the trochanter, beneath the anterior superior spinous process of the ilium, or below the fold of the nates; hectic fever, followed frequently by death.

The *treatment* of morbus coxæ is similar to that recommended for white swelling. Young subjects sometimes recover from an attack of morbus coxæ, adults seldom. Recovery is effected by the ceasing of the ulcerative process in the bones of the articulation, followed by false anchylosis, which is formed by a condensation of the ligaments. Bony or true anchylosis rarely takes place. More frequently a false joint is formed between the upper extremity of the femur, and the dorsum of the ilium against which it rests.

In morbus coxæ both the head of the femur and the acetabulum become carious; the former is absorbed, the latter is much widened. In some cases the caries makes its way through the bottom of the acetabulum, when collections of matter form in the bottom of the pelvis.

Morbus coxæ senilis. This disease appears only in old persons; it is characterized by a dull, heavy pain in the hip-joint, followed by weakness and wasting of the limbs. The pain is increased by change in the weather, particularly when it is damp and cold. The great trochanter soon projects more than in its natural condition. The disease consists in a chronic enlargement of the head of the femur, the cartilage of which is absorbed, its place being supplied by a hard, ivory-like deposit; the neck of the bone is shortened, the ligamentum teres absorbed, and the acetabulum widened. Abscesses do not form in it, nor is it ever fatal. Similar diseases to those described as affecting the hip and knee-joint attack the other joints of the body. Their general course is the same. They are seldom however fatal, although often requiring amputation to preserve the patient's life. In diseases of the elbow the swelling occurs principally above the olecranon, under the extensor muscles of the forearm; in the ankle it is between the lateral ligaments and the tendons in front of the joint. A carious condition of the carpal and tarsal bones is frequently met with.

Wounds of the joints. When the interior of a joint is wounded, the synovia escapes. The wound should be closed immediately, and made to unite, if possible, by the first intention, and all symptoms of inflammation met by the most active treatment.

Foreign bodies in joints. The knee-joint is most subject to the formation of loose cartilaginous bodies in its interior. These are considered by some to be produced from the inner surface of the synovial membrane, whence they drop off into the articulation, and by others to be formed by a deposit of lymph or blood on the outer surface of the membrane, which deposit becoming organized soon projects into the articulation, and, being detached by sudden violence, lies loose in its interior. Foreign bodies in the interior of a joint are productive of much distress to the patient, as they are frequently, in walking, caught between the extremities of the bones, and thus cause excruciating pain, followed by inflammation of the synovial membrane. Repeated attacks of this description may induce a chronic inflammation of the joint, which may terminate in its disorganization.

The *treatment* of foreign bodies consists in moderating the inflammation of the joint when present, and subsequently removing them by making a valvular incision on the inner side of and into the articulation, when, by moderate pressure, the bodies will be discharged; the wound should be immediately closed, and made to unite by the first intention. The violent attacks of inflammation of the joint, that have so frequently followed this operation, have deterred many surgeons from its performance; most prefer the wearing of a laced knee-cap over the joint, which fixes the foreign bodies to one position.

ON DISLOCATIONS.

A joint is said to be dislocated, or luxated, when the articular surfaces of the bones, which enter into its formation, are so displaced as not to correspond to each other. Dislocations are produced either by external violence, such as blows and falls, or by the action of muscles.

The *general symptoms* of a dislocation are, deformity, shortening of the limb, (the dislocation of the humerus into the axilla, and of the femur into the foramen ovale, being the only cases in which the limb is elongated,) loss of power and motion in the part, more or less swelling and pain, which is increased on moving the limb. Dislocations should be reduced as soon after their occurrence as possible, that advantage may be taken of the faintness of the patient, and the relaxed state of most of the muscles. In a short time the patient recovers from the shock of the accident, the muscles contract, so as to accommodate themselves to the displaced bone, and effusion takes place; all of which circumstances conspire to render the reduction more difficult. The capsular ligament was formerly supposed to oppose the reduction of a dislocation; this is found not to be the case, as that structure is always extensively torn. When a dislocation has been left unreduced, a new joint is formed, for the head of the bone displaced, the old socket becoming absorbed or filled up. Dislocations are, in general, reduced by manual extension, but, when this cannot be accomplished, the pulleys are resorted to, and the patient weakened by bloodletting, and the administration of tartar emetic, tobacco-enemata, &c. The pulleys are to be preferred in the reduction of the dislocations of the larger articulations, for by their use the extending force is rendered more constant and regular, by which the opposing muscles are at length overpowered. Dislocations are most usually confounded with fractures. They may be distinguished by their peculiar and the following general characters: in dislocations the mobility of the limb is less than natural, in fractures greater; there is crepitus in fractures, none in dislocations, excepting a grating of the synovia, which soon disappears in moving the limb; in fractures the deformity is easily removed, but soon returns, unless prevented by appropriate treatment; in dislocations the deformity is removed with difficulty, but is not liable to return, if the limb be kept quiet. Fractures occur generally in advanced life, dislocations in the young subject.

Dislocations of the hip-joint. The head of the femur may be dislocated in at least four directions, viz.

Upwards and *backwards*, on the dorsum of the ilium.
Backwards into the sciatic notch.
Upwards and *forwards* on the horizontal ramus of the pubes.
Downwards and *forwards* into the foramen ovale.

Of twenty dislocations of the hip twelve are on the dorsum of the ilium, five into the sciatic notch, one on the pubes, and two into the foramen ovale.

Dislocation upwards and backwards, or *on the dorsum of the ilium. Causes:* Falls on the outer and lower part of the limb (generally the external condyle of the femur) while the limb is in a state of adduction, and brought slightly forwards.

Symptoms. The limb is from one inch to one inch and a half shorter than its fellow; the thigh is a little bent and carried inwards; the knee inclines more forwards and inwards than the opposite one, which it crosses partially; the leg and thigh are turned inwards, and the foot points in this direction, the toes resting against or upon the tarsus of the other foot; the trochanter major is raised, turned forwards, and approximates the anterior superior spine of the ilium, but is less prominent than natural; the head of the femur is turned backwards, and may be distinguished by moving the limb; the foot can be turned inwards, but not outwards, without much pain; the thigh is with difficulty separated from the opposite one, but may be slightly bent across it with facility.

A few rare cases of dislocation on the dorsum of the ilium are recorded, in which the head of the femur was turned forwards and the trochanter backwards. In such the limb is rotated outwards.

Reduction. Place the patient in the horizontal position, on the side opposite the injured limb, upon a table firmly fixed, or a large four-post bedstead. A sheet, folded longitudinally, is first to be placed under the perineum, avoiding the pudenda; one end being carried behind the patient, the other before him; the two ends are to be fastened to one of the legs of the table or posts of the bed. Thus, the pelvis will be fixed, so as to allow the necessary extension of the thigh-bone. A wetted cloth is now passed round the thigh, directly above the knee, and over this the leather strap applied, to which the pulley is to be fixed. The extension is now to be made in the line of the limb, that is, brought across the other thigh, a little above the knee. As soon as the head of the bone has been brought on a level with the acetabulum, by the assistants, who are making the extension, the surgeon is to force it into the cavity of the acetabulum, by pressing on the great trochanter, or by rotating the knee gently outwards. When there is difficulty in bringing the head of the bone over the edge of the acetabulum, Sir A. Cooper raises it by placing his arm under the joint. The disappearance of all the symptoms, and the noise made by the head of the bone, when it slips into the acetabulum, denote that the reduction is effected. This noise, however, is not always made, when pulleys are used. The bone is afterwards to be kept from slipping out again, by tying the patient's thighs together, with a bandage placed a little above the knees. The patient should be kept in bed at least three weeks, use moderate diet, and have the joint rubbed with a camphorated liniment. Due time must be given for the lacerated ligaments to unite, and the sprained parts to recover; premature exercise may bring on inflammation and irremediable disease in the joint. In this dislocation the head of the femur rests on the dorsum of the ilium, covered by the gluteus maximus and medius, having lacerated some of the fibres of the gluteus minimus; the small muscles about the joint, viz. the pyriformis, gemelli obturators, and quadratus femoris, are either torn or put on the stretch; the psoas magnus and iliacus internus are also extended, and some of the neighbouring vessels and nerves injured.

Dislocation backwards into the sciatic notch. This dislocation is caused like that on the dorsum of the ilium, but when the thigh is somewhat more advanced. In this case, according to Sir A. Cooper, the head of the femur is placed on the pyriformis muscle, between the upper edge of the sciatic notch and the great sciatic ligament, being behind the acetabulum, and a little above the level of the middle of that cavity.

Symptoms. The limb is generally not more than half an inch shorter than its fellow, and the knee and foot are turned inwards. The thigh inclines a little forwards, the knee is slightly bent, and the limb is so fixed that flexion and rotation are, in a great measure, prevented. The other symptoms of the dislocation are the same as those of the displacement on the dorsum of the ilium, but are not so distinctly marked. The head of the bone is felt with difficulty from its being sunk in the sciatic notch, and the great trochanter is removed further from the spine of the ilium. *Reduction:* The pelvis being fixed, the extension is to be made downwards and forwards, across the middle of the other thigh, so as to dislodge the head of the bone, while the surgeon, with a napkin placed below the trochanter minor, elevates the upper part of the femur towards the acetabulum.

Dislocation upwards and forwards on the horizontal ramus of the pubes. This accident occurs when the thigh is forcibly extended, that is, brought behind the vertical line of the trunk; as, for example, a person, whilst walking, puts his foot into some unsuspected hole, he throws his body suddenly backwards to preserve his equilibrium, and the head of the bone starts forwards on the pubes. *Symptoms:* The limb is rotated outwards, and cannot be turned inwards, it is shortened by an inch or an inch and a half, the trochanter major is nearer the anterior superior spinous process of the ilium than natural, the head of the bone forms a tumour in the groin above the level of, but under, Poupart's ligament, on the outside of the femoral artery and vein, where it can be distinctly felt. By the stretching of the anterior crural nerve, which lies over the neck of the bone, great pain, numbness, and even paralysis, are liable to be produced. The knee is generally carried backwards. *Reduction:* The extension is to be made in a line behind the axis of the body, so as to draw the thigh bone backwards, and when that has been continued for some time, a napkin is to be put under the upper part of the bone, and its head lifted over the pubes and edge of the acetabulum.

Dislocation downwards and forwards into the obturator foramen. This accident occurs when the thighs are widely separated, the force being applied on the inner side of the limb, the pelvis being fixed, or at its upper part near the joint, when the foot rests against the ground. *Symptoms:* In general the limb is two inches longer than its fellow, the head of the femur being lower than the acetabulum; the trochanter major, which is less prominent than natural, is removed to a greater distance from the anterior superior spinous process of the ilium, and the thigh is flattened in consequence of the elongation of the muscles. A hard round tumour is felt at the inner and superior part of the thigh towards the perineum. The leg is slightly bent, and the foot is brought forwards, but turned neither outwards nor inwards, still there is variety in this respect. The body is bent in consequence of the tense state of the psoas and iliacus muscles; the knees are widely separated. *Reduction:* Place the patient on his back, separate the thighs as widely as possible, and place a girth between the pudendum and upper part of the thigh, fix the girth to a staple in the wall placed on the side of the patient corresponding to the injured limb, and then take hold of the ankle of the dislocated limb and draw it over the other leg, or, if the thigh be very large, behind the sound limb, when the head of the bone usually slips into the socket. Take care not to advance the leg too much, as the head of the bone would be forced behind the acetabulum into the sciatic notch, from which it would be extremely difficult to remove it. This accident is termed the *consecutive* dislocation of the hip-joint. In the dislocation into the foramen ovale the head of the bone rests between the obturator ligament and obturator externus muscle, which is the only muscle relaxed in this dislocation. Dupuytren has described a congenital dislocation of the hip-joint in which the head of the femur on one or both sides is dislocated on the dorsum of the ilium of the fœtus in utero. The femur becomes dislocated from disease, as in morbus coxarius. The brim of the acetabulum is sometimes fractured in conjunction with a dislocation of the head of the femur. The dislocation being reduced, the limb should be kept completely at rest, and compresses applied, so as to preserve the broken bones in apposition until union has taken place.

Dislocation of the patella. The patella may be luxated in two directions, namely, outwards and inwards. Dislocation *outwards* is much the more frequent, being caused by the oblique direction inwards, in which the rectus femoris muscle descends to the patella, and the ligamentum patellæ at the same time passing outwards; when, therefore, the muscle contracts, it tends to bring all these parts to a straight line, and thus the bone is dislocated outwards. The patella may be thrown outwards by falls on its inner edge. *Symptoms:* The dislocated bone is felt on the outer edge of the external condyle of the femur, the limb approaches to a state of extension, and the motion of the knee is limited. *Reduction:* Raise the limb nearly to a right angle with the trunk, so as to relax the extensor muscles, and then press the patella inwards. Dislocation *inwards* is of rare occurrence; it is caused by falls or blows on the outer edge of the patella. A dislocation upwards of the patella, accompanied by a rupture of the ligamentum patellæ, is described by some. It is only a retraction of the bone upwards, caused by the action of the extensor muscles, when the ligament is ruptured.

Dislocation of the knee-joint. The knee may be dislocated either forwards, backwards, inwards, or outwards. These accidents are caused by great violence. They are easily recognized by the projections of the heads of the bones, and are reduced without difficulty, by moderate extension and pushing the tibia to its natural position.

Hey's dislocation of the knee-joint. This accident, called by Mr. Hey the internal derangement of the knee-joint, is now considered to be a displacement of one or both condyles of the femur from the corresponding semilunar cartilages, most frequently the internal. This accident is, in general, caused by the point of the foot, whilst everted, striking forcibly against any projection, when pain is immediately felt in the knee, and the patient becomes incapable of perfectly extending the leg. It has also occurred by a sudden twist of the knee-joint. *Symptoms:* When no contusion has occurred, or the effects of it are removed, the joint, with respect to shape, appears uninjured. If there is any deviation from its usual appearance, it is that the ligament of the patella seems more relaxed than that of the sound limb. The leg is readily bent or extended by the hands of the surgeon, and without pain to the patient; at most, the degree of uneasiness caused by this flexion and extension is trifling. But the patient himself cannot freely bend nor perfectly extend the limb; in walking he is compelled to walk with the knee slightly flexed. Yet, though the leg is stiff in walking, it may be freely moved while the patient is sitting down. *Reduction:* Place the patient on an elevated seat, extend the joint, place one hand above the knee, and with the other move the leg suddenly backwards, so as to make as acute an angle as possible, and the cartilage slips into its place.

Dislocations of the ankle-joint. The tibia is dislocated from the astragalus in four directions, viz., *inwards, outwards, forwards,* and *backwards.* Dislocation *inwards* is combined with fracture of the fibula, and is generally known as Pott's dislocation or fracture. It has been described particularly, when treating of fractures. Dislocation of the tibia *outwards* is of rare occurrence. It is caused by the wheel of a heavy carriage passing over the leg, or by a violent twist of the foot inwards, as in jumping or falling. *Symptoms:* The foot is thrown inwards, its outer edge resting upon the ground, and considerable projection is made by the malleolus externus under the skin. *Reduction:* Relax the gastrocnemii muscles, draw down the foot in the axis of the leg, and push the lower extremity of the tibia inwards towards the astragalus. The internal malleolus is always broken in this dislocation, and most frequently the external malleolus also. It is the most dangerous of the dislocations of the ankle-joint, from the great violence required to produce it.

Dislocation *forwards.* This arises from the body falling backwards whilst the foot is confined, as in jumping from a carriage in rapid motion with the toe pointed forwards. *Symptoms:* The foot appears much shortened and fixed, and the toes pointed to the ground. The lower end of the tibia forms a hard swelling on the middle of the tarsus. The heel appears lengthened, and there is a depression before the tendo-achillis. *Reduction:* Place the patient in bed on his back, let an assistant grasp the thigh at its lower part and draw it towards the body, whilst another pulls the foot in a line from the leg, then push the tibia back, so as to bring it into its proper place. During the after-treatment the foot should be kept flexed at right angles with the leg, so as to prevent a recurrence of the accident. In this dislocation the tibia rests on the navicular and internal cuneiform bones, the fibula is broken about three inches above the external malleolus, which is carried forwards with the tibia. The tibia may be partially dislocated forwards on the one half of the astragalus and os naviculare. Its symptoms are the same, but not so well marked, as the complete dislocation.

Dislocation *backwards* has never been seen by Sir A. Cooper.

The *tarsal bones* are sometimes, but rarely, dislocated. The astragalus is most frequently displaced, generally forwards, and to one side, either inwards or outwards. The luxated bone should be reduced, if possible, by extension and making pressure on the bone itself; where this cannot be effected, the integuments over the displaced bone generally slough, exfoliation takes place, and amputation may become necessary. When the bone protrudes through the skin and cannot be reduced, it should be at once cut away and the wound be closed.

The *phalanges* of the toes are sometimes dislocated, and the first bone of the great toe is frequently luxated from the first metatarsal bone: these cases are not attended with any remarkable symptoms, and are reduced without difficulty.

Dislocations of the *clavicle.* The clavicle is more frequently dislocated at its acromial than its sternal end. The *sternal* extremity of this bone is subject to be dislocated in two directions, viz., forwards and backwards. The dislocation *forwards* is much the more frequent. It is caused by falls on the shoulder. *Symptoms:* The end of the bone forms a distinct swelling on the fore and upper part of the sternum, and if the fingers be carried upon the surface of the sternum upwards, this projection stops them. *Reduction:* Place the knee against the spine and draw back the shoulders, when the bone at once slips into its place. This dislocation is treated by the application of the clavicular bandage, the arm being supported in a sling.

Dislocation *backwards* has only been seen as a consequence of disease of the spine. In one case the end of the bone pressed on the œsophagus, and was removed with the saw.

Dislocation of the *acromial* end of the clavicle. This takes place in but one direction, that is, upwards and backwards, and is caused by falls on the shoulder. *Symptoms:* The shoulder drops and falls inwards towards the thorax, the end of the bone projects, and may be felt by running the fingers along the spine of the scapula, when they will be stopped by the projecting bone. *Reduction:* Place the knee between the shoulders, and draw these backwards and upwards. This accident requires a pad in the axilla, and that the arm should be supported, in addition to the use of the clavicular bandage. These accidents frequently leave some deformity.

Dislocation of the shoulder-joint. The head of the humerus may be dislocated in three directions, viz.

Downwards and inwards, into the axilla.
Upwards and forwards, under the pectoral muscle.
Backwards, on the dorsum of the scapula.

Dislocation downwards and inwards into the axilla. This is of more frequent occurrence than all the other dislocations of the body united. It is caused by falls on the upper part of the arm or on the inner side of the hand or elbow, when the arm is raised from the side, the head of the bone being then drawn downwards by the action of the latissimus dorsi and pectoralis major muscles. *Symptoms:* The acromion projects, the natural rotundity of the shoulder is lost, by the deltoid being flattened and drawn down with the head of the bone, the arm is elongated, its axis inclines inwards towards the axilla, the elbow is with difficulty brought to the side, from the head of the bone being pressed in the attempt, against the axillary plexus, and from its being hitched against the lower edge of the glenoid cavity, the elbow-joint is flexed, the forearm and hand are swollen and supported by the opposite hand of the patient; on raising the arm from the side, and passing the hand into the axilla, the head of the humerus is distinctly felt. The patient is unable to raise his hand to his head, but can swing the arm a little forwards and backwards. *Reduction:* Place the patient in a chair, let the scapula be well secured by a bandage passed over it, with a slit in it to receive the arm and buckled over the acromion; this keeps the bandage close up in the axilla, and more completely fixes the scapula: apply the extending straps round the arm a little above the elbow, raise the arm to a little above a right angle with the body, so as to relax the deltoid and supra-spinatus muscles. Make extension from the arm, and counter-extension from the scapular bandage. After the extension has been made a few minutes, the surgeon should place his knee in the axilla, resting his foot on the chair on which the patient sits, and raise his knee by extending his foot; and placing his hand at the same time on the acromion, he pushes it downwards, when the head of the bone usually slips into its place. If the dislocation be of long standing, the pulleys will be necessary. In recent dislocation, and especially in delicate persons, the reduction may be effected by placing the knee in the axilla, and making extension with one hand from the arm of the patient, whilst the other presses down the shoulders, or by placing the heel in the axilla, as follows: Lay the patient on his back, either on a bed or sofa, and bring him near the edge of it; make extension from the arm by means of a welted roller passed round it, sit on the edge of the bed, place your heel in the axilla, and extend the arm; the dislocation will be reduced in a few minutes.

In this dislocation the head of the humerus rests on the inferior or axillary border of the scapula, or rather between it and the edge of the subscapularis, some of whose fibres are, in general, torn from the bone immediately beneath the neck of the scapula, having the long head of the triceps posterior to it. The capsular muscles of the joint are usually torn or much stretched, the deltoid and long head of the triceps are extended, the pectoralis major and latissimus dorsi relaxed. The circumflex nerve is not unfrequently lacerated, or otherwise injured, causing a paralysis of the deltoid.

Dislocation upwards and forwards under the pectoral muscle. This accident takes place when the arm is thrown rather behind the centre of the trunk. *Symptoms:* The projection of the acromion appears greater from the depression of the deltoid being more considerable. There is a prominence to be observed beneath the middle of the clavicle, and, on rotating the arm, the head of the bone may be felt to roll, the elbow is thrown from the side, and, at the same time, carried backwards, and the motions of the arm are more confined than in the dislocation into the axilla. *Reduction:* The dislocation is reduced by the same means as are used in the dislocation into the axilla. The extension should be made by first drawing the arm obliquely downwards and backwards, until the head of the bone has passed the coracoid process, then it may be raised in a horizontal direction, when, by continuing the extension or by the pressure of the heel in the axilla, the bone will be easily returned. In this dislocation the head of the humerus rests on the second and third ribs beneath the clavicle and internal to the coracoid process.

Dislocation backwards, on the dorsum of the scapula, is of rare occurrence. It takes place when the arm is brought forwards in front of the central line of the trunk. It is readily distinguished by the projection of the head of the bone, and by its following the movements of the elbow, when rotated. In reducing this dislocation, the arm should be drawn forwards. The head of the humerus rests in this dislocation, on the dorsum of the scapula, immediately beneath its spine, and covered by the infra-spinatus.

A *subluxation* of the head of the humerus, in which the bone rests beneath the edge of the glenoid cavity and the coracoid process, is occasionally described as a fourth dislocation of the shoulder-joint. It presents most of the symptoms of the dislocation into the axilla, but in a minor degree. It is *reduced* by making extension in a direction backwards. Dislocations of the shoulder-joint are most likely to be confounded with fractures of the acromion, of the neck of the scapula, and of the neck of the humerus.

Dislocations of the elbow-joint. The elbow is subject to five dislocations, viz.

Both bones *backwards;*
Lateral displacement, either *inwards* or *outwards;*
The ulna alone *backwards;*
The radius *forwards;*
The radius *backwards.*

Dislocation of both radius and ulna backwards. This is the most frequent displacement of the elbow. It is caused by the person, when falling, putting out his hand to save himself; but the arm not being perfectly extended, the whole weight of the body is thrown upon the radius and ulna, and they are forced behind the axis of the humerus

Symptoms. There is a considerable projection, formed posteriorly by the ends of the bones, and *above* this a depression; there is also another projection on the front of the joint, formed by the end of the humerus, and *below* this a depression; on each side of the olecranon there is a hollow. The forearm is shortened and in a state of supination, and cannot be pronated.

Reduction. Place the patient sitting on a chair, take hold of his wrist and put your knee in front of the elbow-joint; then bend the forearm, and at the same time press upon the radius and ulna with the knee, so as to separate them from the humerus, and throw the coronoid process of the ulna from the posterior humeral fossa, where it is lodged. Whilst the pressure is kept up by the knee, the arm is to be forcibly, at the same time gradually, bent, and the bones will slip into their places. After the reduction, the elbow should be kept flexed. In this dislocation, the coronoid process is lodged in the posterior humeral fossa, the head of the radius lies on the back of the external condyle. The humerus descends on the anterior surface of the radius and ulna, as far as the insertions of the brachialis anticus and biceps will admit of. This accident is frequently confounded with fracture of the humerus a little above the elbow.

Lateral dislocation of the elbow. The radius and ulna may be thrown to either side; the displacement is known by the great projection on either side of the joint. In the luxation outwards the coronoid process rests on the posterior surface of the external condyle, and the radius forms a projection to its outer side; in the dislocation inwards the ulna lies on the back of the internal condyle, and the head of the radius is lodged in the posterior humeral fossa. The dislocations are reduced like that of both bones backwards.

Dislocation of the ulna alone backwards. In this dislocation, the deformity of the limb is very great, the forearm and hand being twisted inwards, whilst the olecranon projects backwards. The forearm cannot be extended, nor can it be bent to more than a right angle. Its reduction is more easily accomplished than that of both bones backwards, and is effected by similar means; the forearm being drawn downwards and at the same time outwards, so that the radius may act as a lever by resting against the external condyle.

Dislocation of the radius forwards. This accident happens from a fall on the hand, when the arm is extended, and the radius receives the weight of the body; or by blows on the ulna, which fracture this bone and thus force the radius forwards.

Symptoms. The forearm is slightly bent, but cannot be brought to a right angle with the upper, nor can it be perfectly extended; when bent suddenly flexion is stopped by the head of the radius striking against the fore part of the humerus. The hand is between pronation and supination. By carrying the thumb into the fore part of the elbow-joint, and rotating the hand at the same time, the head of the radius will be felt to rotate also. *Reduction:* Supinate the hand, bend the forearm, and make extension from the hand without including the ulna. In this dislocation the head of the radius rests on the fore part of the humerus, immediately above the external condyle.

Dislocation of the *radius backwards* is very rare. Sir A. Cooper has seen but one such dislocation, and that in the dead subject. It may be reduced by bending the forearm and making extension at the same time.

Dislocations of the wrist-joint. There are four dislocations of the wrist-joint, viz. of both bones *backwards* or *forwards*, of the radius *forwards*, and of the ulna *backwards.*

Dislocation of the radius and ulna backwards is caused by falling on the back of the hand, by which the bones are driven on the dorsum of the carpus. *Symptoms:* A projection behind, formed by the ends of the radius and ulna, and a depression below this; a projection in front, formed by the carpus and a depression above it.

Dislocation of both bones forwards is caused by falls on the palm of the hand. In this the swelling *in front* is formed by the radius and ulna, that *behind*, by the carpus; the depressions are beneath the former, above the latter. Both these dislocations are reduced by making extension from the hand.

Dislocation of the radius forwards. In this case the outer side of the hand is thrown backwards and the inner forwards. The extremity of the bone forms a protuberance on the fore part of the wrist. It is reduced by making extension.

Dislocation of the ulna backwards. The ulna is sometimes separated from the radius by the rupture of the sacciform ligament, and usually projects backwards. It is known by its projecting on the dorsum of the os cuneiforme, by its being easily returned by pressure to its former situation, and by its rising again when the pressure is removed. When the bone has been returned, place a compress of leather on its extremity and splints on the forearm, so as to keep the bone in its place. Take care that the pressure on the end of the bone does not cause sloughing of the skin.

Dislocation of the bones of the carpus. The bones of the carpus are rarely dislocated. The os magnum is the one which is most frequently displaced and in genera *backwards.* It is caused by falls on the hands. After the reduction of the bone has been effected, straps of adhesive plaster should be bound tightly round the wrist.

The *metacarpal bones* are seldom dislocated, except from extreme violence, as the bursting of guns, &c. These cases usually require amputation. Dislocation of the *phalanges* of the fingers are rare. When the accident does occur, it is more frequently found between the first and second phalanges than between the second and third. It can be readily ascertained by the projection of the first phalanx backwards, while the head of the second can be felt on the fore part, although less distinctly. It is reduced by extension, inclining the joints slightly forwards at the same time.

Dislocations of the thumb. The *metacarpal bone* of the thumb is sometimes dislocated from the trapezium and most frequently inwards. It is detected by the protuberance formed towards the palm of the hand, by the thumb being bent backwards, and not allowing of being brought towards the little finger. The dislocation is reduced by making extension, at the same time bending the thumb inwards, so as to relax the flexor muscles which are the most powerful. In the dislocation backwards the protuberance is formed on the dorsum of the os trapezium.

Dislocation of the first phalanx. The first phalanx of the thumb is generally dislocated on the dorsum of the metacarpal bone, by falls or blows on the extremity of the phalanx whilst partially flexed. *Symptoms:* The end of the phalanx forms a projection on the dorsum of the metacarpal bone; whilst this projects inwards towards the palm of the hand, the first phalanx is forcibly extended or bent backwards, the second is flexed. *Reduction:* This is one of the most difficult dislocations to be reduced. In order to relax the parts as much as possible, the hand should be soaked for a considerable time in warm water, a piece of wetted wash-leather is to be closely wrapped round the first phalanx; a tape, about two yards in length, should be fastened on the leather, with a knot which will not slip, such as sailors call the clove-hitch: an assistant should now firmly press on the metacarpal bone, by putting his middle and first fingers between the forefinger and thumb of the patient, and thus make counter-extension, whilst the surgeon, assisted by others, draws the first phalanx from the metacarpal bone, inclining it at the same time a little towards the palm of the hand. If this should not succeed, the following plan may be adopted. In addition to the apparatus already employed, let a strong worsted tape be carried between the metacarpal bone and forefinger, bend the forearm round a bed-post, and let the tape be firmly tied to it, so as to prevent the hand yielding when extension is made. To the tape surrounding the first phalanx a pulley is to be applied, and extension made, which will generally succeed. Forcible flexion backwards will sometimes reduce the dislocation when all other attempts have failed. Various operations have been recommended to effect reduction when other means have not succeeded, such as division of the lateral ligament, the cutting across the long flexor tendon, or removing the head of the metacarpal bone; but these plans have been so frequently followed by serious consequences, as to render their adoption injudicious.

Dislocation of the second phalanx will be best reduced by grasping firmly the back of the first phalanx with your fingers, and placing the thumb on the fore part of the dislocated phalanx, then bending it on the first as much as you can.

Dislocations of the lower jaw. The lower jaw is subject to two species of dislocation, the *complete* and *partial.*

Complete dislocation is when both condyles are thrown forwards into the zygomatic fossa. This accident is caused by falls or blows on the chin, when the mouth is widely opened, or by opening the mouth widely, as in yawning, laughing, &c. *Symptoms:* The mouth is widely opened, and cannot be closed; the lower teeth are on a line, anterior to the upper; the saliva flows from the mouth in consequence of the irritation of the parotid gland, and the patient being unable to swallow it. There is a depression in front of the meatus auditorius, from the absence of the condyloid process, the ramus of the jaw inclines upwards and forwards, and the coronoid process may be felt in the interior of the mouth. The face appears elongated, and the patient complains of pain, from the stretching of the inferior dental nerve, and the muscles attached to the jaw. *Reduction:* Wrap a silk handkerchief round each thumb, place these in the mouth on the last molar teeth, depress the jaw posteriorly whilst you raise it anteriorly, and, at the same time, press it backwards. In less recent dislocations it will be necessary to place two corks, one on each side, between the molar teeth of the upper and lower jaws, and then elevate the chin anteriorly. When the dislocation is still more difficult of reduction, the patient should be placed in the recumbent position, when more force may be exercised in raising the chin. In this dislocation the condyles are lodged in the zygomatic fossa, and the coronoid processes in front of or immediately beneath the edge of the malar bone.

In the *partial* dislocation of the lower jaw, one condyle only is thrown forwards. The symptoms are much the same as the preceding, except that they are not so strongly marked; the lower jaw is thrown, also, to one side, so as to give the face a twisted appearance: the teeth of the lower do not correspond to those of the upper jaw. It is reduced, like the complete dislocation, the force being applied to one side only. There is a *subluxation* of the lower jaw, which takes place in persons of a delicate relaxed constitution. In this the condyle slips from the interarticular cartilage. The displacement should first be reduced, and the relaxed habit of the patient then removed by the use of tonic medicines.

When a dislocation is combined with fracture, the dislocation should be at once reduced by applying the extending force above the fractured part.

Dislocations of the spine. These accidents are produced only by great violence, as by falls from a height. Dislocation of the vertebræ rarely if ever takes place without a fracture, except in the cervical vertebræ, and particularly between the first and second. The injury is always the more serious the nearer it is to the head. *Symptoms:* Paralysis of the parts of the body below the seat of injury, caused by laceration of the spinal marrow; pressure upon it by the displaced bones, or by effusion of blood into the spinal canal; involuntary discharge of fæces, and retention of urine or stillicidium urinæ shortly before death; flatulent distension of the abdomen from effusion of air into the cavity of the intestines, and a constant erection of the penis, named priapism. These accidents are usually fatal. In injuries of the lower cervical vertebræ, death takes place in a few days; but if the fourth, or any vertebra above it, be injured, death is generally instantaneous, from the paralysis of the muscles of respiration. In injuries below the origin of the phrenic nerve, life may be supported for a short period. A person having a fracture of the dorsal vertebræ commonly lives about a fortnight or three weeks. When the lumbar vertebræ have been injured, the patient may survive for some months. The spinal marrow is subject to concussion from falls or violent blows without the spine being injured. The symptoms are the same as those described as resulting from laceration or pressure on the spinal marrow.

The operation of removing the displaced portions of the vertebræ, in fractures of the spine, has been performed, but as yet without success.

The *treatment* to be adopted consists in the local abstraction of blood by cupping or leeches, the opening of the bowels by means of purgative medicines or enemata, and the drawing off the urine by the catheter. Sloughing of the mucous membrane of the bladder and of the nates are frequent results of injuries of the spine. Concussion of the spinal marrow should be treated antiphlogistically, and calomel be administered as rapidly as possible, so as to prevent the disorganization of the spinal marrow, and cause the absorption of any fluids that may have been effused.

ON COMPOUND DISLOCATIONS.

When a joint is dislocated, and a wound communicating with the articulation has been at the same time inflicted, the accident is called a compound dislocation. Compound dislocations of the large joints are usually fatal, or require amputation. When the smaller joints are affected, as the ankle, elbow, &c. the displaced bones should be reduced if possible, and the external wound closed. When this cannot be effected, the wound should be dilated; and if this do not succeed, the end of the displaced bone should be sawn off, and the parts replaced.

In gunshot wounds of the articulations, the removal of the broken ends of the bones has been found very successful, in many cases superseding amputation. A similar practice has been resorted to in cases of diseased joints, and with rather considerable success, especially by Mr. Syme of Edinburgh.

ON ANEURISM.

An *aneurism* is generally defined as a *pulsating tumour containing blood, and communicating with the interior of an artery.* Although this definition will be found to include the greater number of aneurismal tumours, yet some will be met with, to which it is not strictly applicable. Thus large aneurisms, after some time, lose their pulsation, in consequence of the interior of the tumour becoming nearly filled with successive layers of coagulated blood, which have the effect of resisting the impulse of the artery, and thus prevent it from being distinguished externally ; an aneurism, formed by a dilatation of the capillary veins, does not possess any pulsation, and in the aneurismal varix no distinct tumour exists. In diffused aneurism, the pulsation is either very indistinct, or altogether wanting.

Aneurisms are met with most frequently in the adult subject between the ages of thirty and fifty, and oftener in the male than in the female. Yet no age is wholly exempt from them, as they have been met with before puberty, and in the old subject; indeed, the disease of aneurism by anastomosis does appear first at or immediately after birth, and a wound of a large artery at any period of life may be followed by the formation of an aneurismal tumour. The cause of the greater frequency of aneurism in the adult is the great liability there exists at this period of life to the deposition of steatomatous, atheromatous, or ossific matter between the internal and middle coats of the artery; this portion of the vessel being thus deprived of its elasticity, is more exposed to the impulse of the heart, and thus gives way either by being gradually distended, or by the rupture, first of the internal, and then of the middle coat of the vessel, when the only remaining coat, the cellular, not being possessed of sufficient resistance, yields, and thus gives rise to the formation of a tumour. To this may be added, the greater exertion of the adult exposing the vessel to greater violence, and the disturbance of the circulation produced by mental or other affections, more frequent at this period of life. In the young subject this diseased state of the vessels seldom exists; in the old subject the artery has become so extensively diseased from the deposit of ossific matter, that the vessel at once gives way, and the blood being extravasated in large quantities into the surrounding parts, death ensues without the formation of any aneurism.

Several divisions have been made of aneurism, varying according to their mode of formation, their situation, or other peculiarities.

The most important of these are,

1st. Into the *true* and *false* aneurism. *True* aneurism is that in which the tumour is formed by all the coats of the artery, which, having gradually yielded, form the coverings of the aneurismal swelling. *False* aneurism is that in which the internal and middle coats have given way, and the coverings of the aneurismal swelling are formed by the cellular coat of the vessels or surrounding cellular substance, or both, united by the adhesive inflammation.

As either of these forms of aneurism may be met with in any part of the body, they have been divided, 2dly, into *internal* and *external* aneurisms. *Internal* aneurisms are those which form in any of the cavities of the body, as the thorax and abdomen, and generally affect the aorta, or some of its principal branches. *External* aneurisms are, on the contrary, confined to the vessels of the extremities, the neck or external part of the head.

As the blood may or may not be confined in a cyst, aneurisms are divided, 3dly, into *circumscribed* and *diffused* aneurism. *Circumscribed* aneurism is that in which a distinct sac exists, which confines or circumscribes the blood. In *diffused* aneurism the blood is on the contrary diffused, or extravasated in the surrounding cellular tissue, in consequence of a wound or rupture of all the coats of the artery, or the bursting of the aneurismal sac, so that a circumscribed may ultimately become a diffused aneurism.

4thly, *Traumatic* and *spontaneous* aneurism. The former of these divisions is produced, as the name implies, by the wound of an artery, the latter without such, appearing either spontaneously, or from some very trifling cause, and in almost all cases preceded by a diseased state of the vessel, which has given rise to the aneurismal tumour. Although these divisions of aneurism may appear tedious, they will be found by the student hereafter to be exceedingly useful, as they establish an arrangement of the disease in his mind, especially as the nature, the formation, and the situation of the disease, have much effect on its diagnosis, treatment, and ultimate termination. Whilst the diagnosis of an external aneurism is in general simple, that of an internal aneurism has frequently baffled the most skilful of practitioners: we may resort to an operation in most cases of external aneurism, but such treatment is impossible in the greater number of the internal. In the case of the traumatic aneurism we may tie the artery close to the tumour; in the spontaneous aneurism such treatment is inadmissible, as we tie a diseased vessel.

To the above divisions of aneurism may be added the *aneurismal varix*, *varicose aneurism*, *dissecting aneurism*, and *aneurism by anastomosis*, all of which will be considered when we shall have completed the more important forms above alluded to.

The larger arteries are much more liable to disease of aneurism than the small, and those of the lower than those of the upper extremities; thus Mr. Hodgson has found that, in sixty-three cases, twenty-one were of the ascending aorta, arteria innominata, and arch of the aorta, seven of the descending aorta, two of the carotid artery, five of the subclavian and axillary, twelve of the inguinal artery, fourteen of the femoral and popliteal; of all these, seven only occurred in the female subject. The arteries of the leg or forearm are rarely the seat of aneurism. If we trace the formation of an aneurismal tumour from its first existence, we shall find that, as soon as the internal and middle walls have given way, the blood passes beneath the cellular coat of the vessel, and thus raises it so as to form the swelling; the cellular coat affords a slight barrier to the blood for a short time, but soon yielding, would in its turn burst, and thus cause the death of the patient by the sudden hemorrhage, were it not that the violence done to the surrounding parts by the distension excites the adhesive inflammation, which throws out coagulable lymph; this causing the adhesion of the neighbouring structures, forms the aneurismal sac, and prevents for a further time the distension of the swelling. The tumour having now attained a moderate size, but varying, as is evident it must, according to the resistance of the surrounding tissue, and the greater or less density of the cellular substance, becomes distinct if situated near the surface of the body or extremity, and is in a condition best adapted to the forming of a correct diagnosis on the part of the practitioner.

If the tumour be now examined, it will present all the symptoms characteristic of the disease. Thus we recognize a tumour possessing a pulsation corresponding to the systole and diastole of the heart, and at each impulse of this organ not only pulsating, but undergoing a considerable increase in size, to be distinguished in many cases by the eye, but in all by the practitioner grasping the tumour in his hand, and making slight pressure on it at the same time. This alternate distension and diminution of the tumour is produced by the ingress and egress of the blood into its interior at each beat of the heart. By compressing the tumour it may be made to disappear altogether, or diminish in size, from the fluid blood being forced from it back into the cavity of the artery. On compressing the artery leading to the swelling, the following symptoms present themselves: the tumour loses its pulsation and disappears, but again becomes manifest so soon as the compression is removed. Pressure on the artery below the tumour has the effect of causing an increase in its size and pulsation. At this period the integuments covering the tumour are free from any discoloration, and the patient feels little or no uneasiness from the disease. Occasionally slight pain exists, but this is not serious until the disease attains a larger size and presses on some of the surrounding nerves. On applying the ear or the stethoscope to the aneurismal swelling, a distinct blowing or purring sound is frequently heard.

It is only when aneurism appears at or near to the surface, so as to be exposed either to the eye or the touch, that a correct diagnosis can be hoped for; when the aorta is the seat of the disease, no distinct symptoms present themselves, until the tumour approaches the surface, the only pain present being produced by the pressure of the tumour on the surrounding organs, and which gives rise to a complexity equally distressing to the patient and embarrassing to the practitioner. This may be called the first stage of aneurism.

Let us now proceed to the second or more advanced stage. The blood being impelled into the aneurismal tumour by each systole of the heart, it gradually enlarges by the giving way of the parietes of the sac, and their gradual absorption. Each structure becomes absorbed as it presents itself, bone, cartilage, or membrane. Cartilage is not so rapidly removed as bone, from its yielding to the pressure of the tumour, and being less highly organized than osseous substance. The tumour is, however, prevented from bursting by the adhesive inflammation preceding the process of absorption, and enlisting in its service each successive structure, until it contracts adhesion to the skin itself. The tumour differs now in many particulars from those present in the first or early stage. As the blood passes into the interior of the enlarged sac, and becomes more and more removed from the agency of the heart, it coagulates, and deposits in the aneurismal cavity successive layers of coagulated fibrin, by which the tumour becomes firm, yielding but little to pressure either applied to it or the artery above it, and loses its distinct pulsation, and that remarkable distension of it at each systole of the heart. Still, as some fluid blood is contained in the aneurismal sac, it is capable of a slight diminution of size on pressure being properly applied. The integuments now become partially discoloured, and the surrounding nerves being compressed by the swelling, the patient begins to suffer the most excruciating pains shooting up and down the limb in the course of the nerves. The parts below the tumour become swollen and œdematous, and the veins distended from the pressure of the tumour on the absorbent and venous trunks. The patient's limb, if it be one of the lower extremities that is the seat of the disease, " feels asleep," to make use of a common expression, and the integuments assume a bluish red appearance, and diminish in temperature. It is in this stage of the disease that the case most frequently falls under the observation of the surgeon.

Should the disease be neglected, it rapidly advances to its third or last stage. The tumour, now meeting with but little resistance from the integuments, spreads in every direction, its interior becomes filled with large masses of coagula, it loses its pulsation, and gradually makes its way through the skin. This, as the disease advances, becomes much discoloured; from a slight blush first observed on its surface, the colour increases in depth and extent, until at length it assumes a dark red or livid hue. The aneurism now threatens to burst. One portion of the tumour, frequently, but not always, its centre, becomes more deeply coloured, and more pointed than the rest; over this point the cuticle becomes detached, and a slough forms in the cutis, which gradually yielding, at length admits of the escape, first of a portion of the contents of the sac, and then of the fluid blood. The hemorrhage may be restrained at first, but soon returns, and at no distant period puts an end to the life and the sufferings of the patient. This is the course of an aneurism which protrudes and bursts externally. When the tumour opens on a mucous surface, as into the stomach, intestines, &c. the same process is observed, but not so when it makes its way through a serous membrane; this latter yields by a *rent* or fissure being made through it.

This, although the general, is not the invariable termination of an aneurismal tumour when left to nature; it is possible that a *spontaneous* or *natural* cure may take place, and the patient recover. This may be effected by the complete filling up of the aneurismal sac with coagulated blood. The sac then compresses the artery, and causes its obliteration. A cure may be also produced by the aneurismal or other tumour being forced upon the artery leading to the disease, thus causing its obliteration as if a ligature had been applied upon it. Cases of spontaneous cure have also occurred from inflammation and sloughing of the sac and neighbouring parts, in which process the artery becomes obliterated, and the slough ultimately thrown off. Sloughing of the aneurismal sac is, notwithstanding, more to be dreaded than hoped for, as but few constitutions could bear up against the numerous trials that such a process exposes them to.

On making a post mortem examination of an aneurismal tumour, the skin is found extremely thin, and confounded as it were with the sac. The cells of the cellular substance are filled with serum, or obliterated by adhesion. The adjacent muscles are stretched, displaced, and many of them wholly or partially absorbed. The neighbouring nerves are displaced, and where they have been subjected to the pressure of the tumour, are flattened, spread out, and inflamed, and are frequently so changed as scarcely to admit of recognition. Lastly, the cartilages and bones are removed, the bones presenting a rough irregular appearance, and the cartilages as in the intervertebral substance of the spine, projecting beyond the osseous structure. The interior of the sac is nearly filled with coagulated blood, the outer portion of which is arranged in concentric irregular laminæ of fibrine of a whitish colour, which gradually diminishes to the centre of the sac, where the blood is in clots of a dark venous colour. The opening from the artery into the sac varies much in size, and presents its edges smooth and continuous (apparently) with the parietes of the sac, or in some places jagged and irregular.

As a mistake in our diagnosis of an aneurism is one of the most serious to which the surgeon is exposed, much caution is necessary in coming to a correct conclusion on the subject. In the second stage but little difficulty exists, at least when the aneurism has approached the surface; but not so in the more advanced stage. We have already said, that in this the aneurismal sac being filled with coagula, loses its pulsation; how likely, then, is the practitioner to mistake it for a fungous or other tumour, or a chronic collection of matter, and either plunge his lancet into its interior in the latter case, or proceed to the operation of amputation in the former. It is sufficient to say, that such unfortunate mistakes have occurred.

Again, other tumours may have a pulsation communicated to them from a neighbouring artery, and may be mistaken for an aneurism. Where we can draw the tumour from off the artery, the pulsation ceases, and the error is thus avoided, but this we cannot always effect: a chronic abscess may present itself in the lumbar region, and have a pulsation communicated to it by the aorta, or there may be no pulsation in it, and yet how are we to decide? In many cases the fluctuation of the matter will be such as to distinguish, but this is not always present. So great, indeed, has the difficulty been found in some cases, that the surgeon is obliged to pass a grooved needle into the swelling, and thus ascertain its nature by the escape of its contents along the groove. If the tumour be aneurismal, the wound should be immediately closed, and appropriate treatment adopted. In most cases the alternate contraction and enlargement of the tumour at each pulsation of the heart, and its capability of being diminished in size by pressure, or by stopping the flow of blood into it, will be found of much value in aiding us to form a correct diagnosis.

TREATMENT OF ANEURISM.

The treatment of aneurism may be comprised under the two heads of medical and surgical. Internal aneurisms, at least those which affect the aorta, can only be treated medically, or by those medicines which act through the medium of the constitution. The great object which we should have in view in the treatment of these affections is the lessening the force of the circulation in order that we may thus by moderating the heart's action, retard the increase of the aneurismal sac, and dispose the blood to become coagulated in its interior, and thus produce its cure by obliteration. Although it is but in a few instances indeed that we can hope for so desirable a consummation, yet we shall by so doing relieve the sufferings of the patient, and prolong his life to a much longer period than if the case be left to nature. For this purpose, strict rest and a moderate regimen should be enjoined, and the action of the heart moderated by occasional bleeding from the arm, and by the use of digitalis either in the form of tincture, of which six to ten minims may be given three times a day, or in powder, of which one to two grains may be exhibited at a dose. The occasional use of opium will also be found beneficial, as also the local abstraction of blood by means of leeches or cupping. General bloodletting should not be carried further than from eight to ten ounces at a time, and that at reasonable intervals, as it is our object to avoid fainting and prevent reaction. We should at the same time not repeat it too frequently, as we may otherwise induce a state of irritation more likely to frustrate than conduce to the object we have in view, and bring on a dropsical state of the patient, which frequent bloodlettings are known to induce.

Of late a generous use of food has been recommended in order that an additional quantity of fibrine may be formed in the blood, and thus dispose to its deposit in the aneurismal sac. When an internal aneurism attains a large size and approaches the surface, as it frequently does, either on the anterior or posterior surface of the trunk, the use of cold applications will be found beneficial in restraining the inflammatory action of the skin. When the sac is likely to burst, the life of the patient may be prolonged by the use of adhesive straps, bandages, &c.

External aneurism also may be treated on a similar principle, and by the application of a ligature on the artery leading to the tumour. In these aneurisms we are in general enabled to try the effects of pressure previously to resorting to an operation.

Of external aneurisms the *popliteal* is the most frequent; it occurs in persons who from their avocations retain the limbs in the flexed positions, as in postilions, &c. The artery appears in such to accommodate itself to the flexed position of the joint; under these circumstances if any violent exertion of the limb be made, the vessel gives way, and the aneurism is formed; yet the disease frequently appears in persons who have not been exposed to one or other of these causes. We shall select then a case of popliteal aneurism, and from this point out the treatment to be adopted in most cases of external aneurism.

When the patient first presents himself he is seldom in a fit condition for the attempting of any surgical measures; by a few day's rest and the antiphlogistic regimen, such a change will be effected as will enable us to proceed with more active treatment. Compression should first be tried : this is to be effected by means of bandages applied round the limb, commencing at the toes, each of which should be included, as far as is possible, in a distinct bandage; the leg is then to be carefully bandaged, and a graduated compress being placed over the aneurismal tumour, the bandage is to be carried upwards round the thigh to the pelvis, one or more compresses being placed on the course of the femoral artery. By these means the blood will be prevented from entering the sac, its contents will become more solid, and the sides of the artery being compressed together, its obliteration may be expected. Notwithstanding that this plan of treatment has been frequently adopted, it has been seldom found successful; indeed there is but one situation in the human body, namely, at the bend of the elbow, in which we can expect success. Here the artery is superficial, it rests on the lower part of the humerus with the intervention of the brachialis anticus muscle, the nerve does not interfere with the compression, nor is there any resisting fascia, or other structure to bear it off from the vessel. Not so with the popliteal artery; for the vessel here lies deep: the popliteal nerve is superficial, and runs almost directly in the course of the artery, and the popliteal fascia with the hamstring tendons resist any compression we can be justified in resorting to; the vein too may be compressed at the same time and thus retard the return of the blood from the lower part of the limb.

Independently of these circumstances, the aneurismal tumour may be in such a condition as not to admit of compression, its size may be too great, or the integuments covering it may be in an inflamed and painful state. When compression is resorted to, the constitutional remedies recommended in the treatment of internal aneurism should be employed. When the tumour appears to diminish in size, its pulsation becoming less distinct, and the limb less painful to the patient, we may expect a favorable termination; on the contrary, if the patient's sufferings are increased, and the integuments of the sac become inflamed without the tumour altering in size, the use of compression is not only likely to be of no avail, but actually prejudicial, as by a perseverance in its adoption, gangrene of the sac or limb may be the consequence. Many other methods of applying compresses have been recommended and tried, but none have been attended with such success as to require notice here.

Compression having failed, the operation for aneurism is to be resorted to. This, the greatest improvement in modern surgery, consists in applying a ligature round the artery leading to the tumour, but at a distance from it. The ancient surgeons were in the habit of cutting through the aneurismal sac, and tying the artery immediately above and below the opening in its parietes; but as they thus secured a diseased vessel, their operations were almost always followed by secondary hemorrhage, from the sloughing of the artery previously to or immediately after the separation of the ligature. Fortunate indeed was the patient considered who recovered with an anchylosed knee-joint. John Hunter first tied the artery at a distance from the disease, and thus, although his operations were not generally successful, (from his not tying the vessel sufficiently remote from the disease,) paved the way to the improvement suggested by Scarpa, of applying the ligature at a still greater distance, viz., in the inguinal region, or, as it is frequently called, Scarpa's triangle.

The artery, let us say the femoral, being exposed, it is gently separated (in order that we may not injure the vasa vasorum), from its surrounding connexions, and the ligature passed round it, taking care to avoid the vein, nerve, or other contiguous structure. The ligature is now to be drawn tightly around the artery, and secured with a double knot, one end being cut short, the other is to be brought out at the wound, which being closed with adhesive plaster and bandage, the patient is to be removed to bed and placed in the recumbent posture, with the knee and thigh supported on a pillow, so as to relax the vessel. In the course of from ten to fourteen or twenty-one days, the ligature separates, the wound closes, the aneurismal tumour loses all pulsation and finally disappears, and the patient recovers the perfect use of the limb.

But let us trace more minutely the successive changes which take place before this favorable termination. The ligature having been firmly tied cuts through the internal and middle coats of the artery, the circulation is thus stopped in its interior, and the blood is forced upon the anastomosing branches, which then gradually enlarge and carry the blood into the part of the vessel below the ligature. It thus enters the artery a second time and makes its way into the aneurismal sac, which again begins to pulsate. This is found to take place generally on the second, third, or fourth day after the operation, and is looked on as a favorable symptom, as it proves the establishment of the collateral circulation. Although the blood thus enters the sac a second time, the cure is not prevented but rather facilitated, as this fluid enters into it in such a feeble stream, from its having passed through the anastomosing branches, and from the same cause having approached to the venous character of blood, whereby its coagulation is more likely to take place; the sac is soon filled with coagula, and thus presses on the diseased artery and causes its obliteration. Before this, however, has taken place, the anastomosing branches have become enlarged, and thus conveying the blood in sufficient quantities to the tibial vessels, the circulation is reestablished. The sac is gradually, i. e. in a few months, absorbed, and a small hard tumour alone tells its former situation.

As these changes are going forwards, the limb is to be carefully attended to, for the stoppage of the circulation is found to cause a diminution in its temperature, and by lessening its vitality weakens its powers of resisting external agents, such as cold, &c. The limb should therefore, immediately after this operation, be enveloped in cotton or flannel, and external warmth applied, if necessary, by means of warm bottles. In the application of the latter remedies, some caution is required, for if used to excess they will stimulate the parts beyond their power of action, and induce mortification. Moist applications should be particularly guarded against, as the evaporation that ensues is highly prejudicial.

The effects and mode of separation of the ligature on the artery are both curious and interesting; the internal and middle coat having been cut through, and the current of the blood in the interior of the vessel arrested, this fluid is thrown on the anastomosing branches; a coagulum now forms in the interior of the secured vessel both below and above the ligature; it is of a conical shape, with the base towards the ligature, the apex in the contrary direction, and extends as far as the next anastomosing branch of importance; by degrees the vessel contracts, the lacerated edges of its wounded coats become inflamed, and throw out coagulable lymph, which, causing their adhesion, seals up each end of the artery, which then contracts still further, and finally becomes obliterated as far as the extent of the coagulum. The *ligature* escapes in the following manner: that portion of the vessel included in the knot forms a slough, which is gradually removed by the process of ulcerative absorption detaching it from the living parts of the vessel; the ligature now is easily withdrawn, or makes its way outwards with the discharge.

We have stated that pulsation returning to the tumour on the third or fourth day is considered a good symptom; when however it appears within twenty-four hours after the operation, it is unfavorable, as indicating (supposing the artery to have been properly secured) the existence of some irregular branch which has conveyed the blood almost directly to the tumour. Such cases should be treated by the use of moderate compression, strict rest, and the antiphlogistic regimen, by which means a successful issue may be obtained.

A limb, on which the operation for the cure of aneurism has been performed, presents, on examination, in some months or years after the operation, the following appearances: the tied artery has degenerated into a ligamentous chord upwards, as far as the next important anastomosing branches, and downwards through the thigh and popliteal space, as far as the origins of the tibial vessels, occasionally a small portion of the artery between the ligature and popliteal space remains pervious; into this the blood is poured, and is again removed by anastomosing branches. The circulation is carried on by the anastomosing branches, a number of which at first become enlarged, but most of them gradually diminish in size and number, until two or three of the largest arteries are left to perform the office. They present a remarkably tortuous appearance.

The operation for the cure of popliteal aneurism may fail in consequence of the supervention of *secondary hemorrhage*, *mortification*, the formation of *abscesses* along the course of the artery, the too free anastomosis of vessels with the sac, and from constitutional causes.

1. *Secondary hemorrhage* occurs sometimes immediately after the operation, from the ligature not having been properly secured, or applied to the vessel. If such should be the case, the wound should be opened, and the artery properly secured. It more frequently occurs at a more distant period, viz. either towards the close of the first week, or about the time of separation of the ligature; in the former case the vessel tied has been most probably in a diseased state; in the latter also this may be the case, or the adhesive inflammation may not have taken place, either from some defect in the constitution, inflammation of the wound, or from the artery having been tied too close to an anastomosing branch, by which the formation of an internal coagulum, and the subsequent contraction of the vessel have been prevented. The bleeding commences in

small quantities, the blood being of a dark colour, escaping without a jet, and in general issuing from the lower extremity of the vessel. Compression should first be tried, and if this fail, the artery should be tied still higher up. This secondary operation seldom succeeds, as the constitution of the patient is not in a fit state for its performance, and the lining membrane of the artery is in general inflamed from the previous operation. Secondary, hemorrhage from the point at which the artery has been last tied, in general terminates the patient's sufferings on the fifth or sixth day.

2. *Mortification* may attack either the limb or the aneurismal tumour. In the former case it proceeds from deficient circulation, and commencing at the toes spreads upwards to a variable extent; the toes alone may suffer, or the whole limb as far as above the tumour may perish. Mortification appears in the course of four or five days after the operation, and is indicated by the deficient temperature, and insensibility of the part, on which dark lines, succeeded by a black spot, frequently appear, followed by the formation of vesications, and other symptoms of gangrene. When the gangrene is partial the efforts of nature need not be interfered with, but when extensive, amputation is to be resorted to. In performing amputation after the operation for the cure of aneurism, the circulation should be previously commanded by every means in our power, as the anastomosing branches having become enlarged, and most probably having lost their contractility from over distension, pour out the blood in large quantities from innumerable orifices.

Mortification of the sac in general occurs where the tumour has been of considerable size. Should the efforts of the patient's system be insufficient to throw off the slough, and establish a cure, amputation is to be performed.

3. *The formation of abscesses along the course of the vessel* should be prevented by pressing out the matter carefully, and then placing compresses and bandages along the course of the artery; if these means should not be effectual, a counter-opening must be made at the most

depending part. The effects of a too free anastomosis have already been mentioned.

Under the head of constitutional causes, may be enumerated the bursting of internal aneurisms, disease of the lungs, or other vital organs, erysipelas, &c.

Many other plans have been recommended for the securing of the artery beyond the aneurismal tumour, such as numerous ligatures, metallic wire, and instruments of various descriptions. They have been all found injudicious.

We need hardly remind the young surgeon that previously to resorting to the operation for aneurism, a careful examination of the patient should be made as to the state of the thoracic and abdominal viscera, the existence of internal aneurisms, &c.

Where an aneurismal tumour is so large that it is likely to impede by its pressure the formation of the collateral circulation, and especially when the tumour is in an inflamed state, amputation is to be preferred.

Aneurism at the bend of the elbow, most frequently the consequence of a wound, is now generally treated by cutting into the tumour, and tying the vessel above and below the wound. Whatever deviation from this line of treatment, a circumscribed aneurism, (in which we have a sac to confine the blood, and thus assist us in our efforts,) may admit of, it is now I believe the almost universal opinion, that diffused aneurism should be treated by this plan alone.

Aneurismal varix and *varicose aneurism* are nearly similar; they are both caused by a wound in which both the artery and vein are implicated; the two vessels being in close apposition, a communication is established between them and thus the arterial blood passes into the veins of the limb. On examination, the veins are found much distended, the extremity swollen, and of a darker colour than natural, the artery above the communication beats violently, its branches below this point pulsate feebly, by applying the ear over the seat of communication a bruit de soufflet, or sometimes a hissing or purring sound, is heard. If in the case of aneurismal varix or varicose aneurism at the bend of the elbow, a ligature be applied round the forearm, and the veins above this be emptied by pressure, they will immediately fill again.

The only difference between these two diseases is, the presence of an intervening sac in varicose aneurism into which the blood is poured by the artery, and from which it is received by the vein. This gives rise to some difference in the treatment. An operation may be resorted to in varicose aneurism where the sac threatens to burst, but no operation is admissible in aneurismal varix. The treatment best adapted to both affections is that of moderate compression by means of bandages, and the keeping the limb as much at rest as possible.

Dissecting aneurism was first described by Mr. Shekleton, and more lately by Mr. Guthrie; it is produced by the blood making its way between the coats of the artery and then entering the vessel at some remote point. The treatment is the same as that for spontaneous aneurism.

Aneurism by anastomosis, (*nævus maternus*.) This disease consists, as its name implies, of a dilatation of anastomosing or capillary vessels; or, according to others, is composed chiefly of a number of cells, into which the blood is poured by the arteries, and from which it is removed by the veins. It appears in general on some part of the head, at or immediately after birth, as a bright spot on the skin, or as a small tumour immediately beneath it, the skin being likewise engaged. Sometimes the disease remains through life without giving the patient uneasiness; but more frequently enlarges in size until it causes great deformity and inconvenience. Should it continue to increase, the integuments become thinned, and at length giving way, a discharge of blood takes place, which, if not restrained, may prove fatal. The disease is easily distinguished, being subcutaneous; the tumour is of a bright-red or sometimes livid colour, attended generally with pulsation, and feels, when compressed between the fingers, like a "bag of earthworms."

Aneurism by anastomosis may be divided into the arterial, venous, or mixed, according as the tumour is formed of arteries, veins, or both these vessels. The venous is of a darker colour than the arterial, and does not possess pulsation; it is not so liable to sudden increase, and is therefore not so dangerous an affection. The mucous membranes are the seat of this disease, as well as the skin.

The treatment recommended for aneurism by anastomosis is exceedingly variable, as follows;

Excision of the tumour, taking care to cut beyond the diseased mass, for if cut into, its vessels do not contract and violent hemorrhage is the consequence.

Tying the artery leading to the tumour. This operation is falling into disuse from the very partial success that has hitherto attended its adoption.

Passing one, two, or more setons through the tumour, and allowing them to remain until they have induced inflammation, which, terminating by effusion of lymph into the cells of the tumour, causes their obliteration, and the removal of the disease.

The introduction of vaccine virus at different points of the tumour, which acts on similar principles. The passing of a needle through the tumour, and obliterating finally its cells.

To which we would add the injection of some stimulating fluid into the cells of the tumour.

Excision of the tumour is now seldom resorted to, as one or other of the four last-mentioned plans has been found very successful. The injection we have not heard of, we merely suggest its adoption.

Many cases of nævus, if attended to in time, will be cured by means of cold applications and moderate compression.

A form of aneurism in which the lining membrane of artery becomes protruded through a rupture of the middle and outer coats has been described, but it is indebted for its existence to the ingenuity of experimenters on lower animals.

ON VARICOSE VEINS.

Veins are said to be varicose when they become permanently dilated and the circulation is so far retarded in them that their cavity is filled with dark coloured blood. The veins of the lower extremities are more subject to this disease than veins in the other parts of the body, although none are wholly exempt from the affection. A varicose state of the veins is produced by any cause which prevents the due return of the blood; thus ligatures passed round the limb, the pregnant uterus, and enlarged liver are fruitful causes of the disease. There seems to be an hereditary predisposition to this affection in some; and tall persons, particularly those who walk and stand much, are more liable to it than others.

Of the veins of the lower extremities, the trunk and branches of saphena major are more frequently varicose, from their superficial course, from being situated immediately beneath the skin, thus wanting the support of the fascia, and from the great length of the trunk. The weight of the column of blood which ascends against gravity, also assists materially in producing the affection. The disease usually commences in the veins about the calf of the leg, generally on the inner side, whence it ascends until it affects all the superficial veins of the extremity, in many cases reaching to the trunk of the femoral vein. The patient suffers but little inconvenience at first, but in the more advanced stages, the varicose vessels become exceedingly painful and the limb swollen and œdematous on using the slightest exertion in the erect posture. The patient is thus often deprived of the use of the limb for some time. In this condition the veins become thick, hard, and tortuous, being much increased in length, and in diameter. Opposite the valves which become ruptured, lymph is poured out so as to form numerous hard, painful, and knotty tumours in the course of the limb. Lymph being also effused into the surrounding cellular tissue, the veins are often matted to the integuments.

The mode of formation of a varicose vein is as follows; the circulation being impeded in the vessel it becomes over distended with blood, which stretching the coats of the vein destroys the action of the nearest valve; in consequence of this, the one immediately beneath having an additional weight to support gives way, and so it proceeds till all the valves are destroyed. The circulation of the blood in the veins being thus retarded, they become filled with dark blood, inflame, and become thickened in their coats, so that when cut across they resemble an artery.

As the disease advances, ulcers form on the limb in the course of the distended veins, and are known by the name of varicose ulcers, being produced in one of the two following ways; first, a varix forms in a particular part of the vessel, and gradually increases in size, forming a tumour; the integuments covering the tumour become inflamed and thinned, ultimately give way, when a profuse discharge of blood takes place from the opening which soon degenerates into an ulcer: 2dly, the patient receives a slight blow or scratch, as by the heel of the opposite foot striking the diseased extremity; inflammation attacks the wound, and an ulcer forms.

A *varicose ulcer* is usually situated on the inner side of the limb, a little above the internal malleolus; it is oval in shape, with its long axis from above downwards; and a thin serous discharge issues from the ulcer; the surrounding skin is of a dark red colour; although not usually painful, it becomes exceedingly so after much exertion.

The *treatment* of varicose veins consists in supporting the distended vessels by means of rollers or a laced stocking. If an ulcer be present it may be dressed with very dilute nitrate of silver solution or lotio nigra, sulphate of zinc solution, &c., over which straps of adhesive plaster are to be applied, so as to cover but not completely surround the limb, from the ankle to within a short distance from the knee; the limb is then surrounded by a bandage. By these means conjoined with strict rest, attention to the bowels and diet, the occasional application of leeches if necessary, the ulcer will be made to heal.

Various plans have been adopted from time to time for causing the obliteration of the diseased veins, and thus to throw the venous circulation on the deeper and more healthy vessels. The first of these is tying the saphena vein on the inner side of the knee. This is accomplished by cutting down on the vein, and applying the ligature around it. Pressure on the vein in this situation has been recommended with the same view, as also the application of caustic, and cutting out a part of the vessel. All these remedies are both dangerous and doubtful; they have often given rise to extensive inflammation of the vein and thus caused the death of the patient; and in the most successful cases have only produced temporary benefit. Sir B. Brodie recommends the division of the diseased branches, (selecting a cluster of the largest and most painful varices,) by the introduction of a peculiar knife, resembling a sharp-pointed bistoury, but sharp on its convex edge; this is passed between the skin and the veins, and the latter are cut across whilst the knife is withdrawn: this plan is liable to the same objections as the other, though not in an equal degree. A still more recent plan is that of dividing the branches in the lower part of the leg, or on the dorsum of the foot.

Velpeau has lately recommended the passing of a needle beneath the varix, and then securing a ligature round it, so as to cause the obliteration of the vessel; this practice has been followed with more success than the plans before mentioned. Inflammation however is apt to attack the leg, and must be actively combated.

Varicose veins sometimes prove fatal from the rupture of a varix and the profuse hemorrhage which ensues. As the blood in such cases may escape from both extremities of the vessel, it is necessary that pressure should be applied both above and below the bleeding point.

Phlebitis. The lining membrane of the venous system is subject to inflammation of an erysipelatous character: it succeeds a wound of the larger veins, and spreads rapidly towards the heart. The inflammation is characterized by pain in the course of the veins, which become thickened by the effusion of lymph into their interior and the surrounding cellular tissue; they are also very tender to the touch.

Abscesses form in the course of the inflamed veins, accompanied by fever of a typhoid character, which soon terminates in death. On a post-mortem examination, collections of pus are frequently found in the cavities of the joints, and in the principal viscera, chiefly in the lungs and the liver. The *treatment* consists in the application of leeches over the course of the inflamed veins and the exhibition of mercury, so as to salivate, if possible, before the inflammation has extended. Phlebitis has frequently ensued from punctured wounds in dissection and post-mortem examinations, especially when the patient has died from puerperal peritonitis.

ON TUMOURS.

Tumours have been defined by the celebrated John Hunter as follows: "a tumour is a circumscribed substance, produced by disease, and different in its nature and consistence from the surrounding parts." Many of the diseases which will be mentioned under this head have been referred to in a previous part of this work, and will therefore be only spoken of cursorily in this division. The arrangement is borrowed from an interesting work on Tumours, by Dr. Warren, of the Harvard University in the United States, and in many instances the description is copied almost *verbatim.* Some diseases met with in that country, but not in our own, are intentionally omitted.

EPIDERMOID TUMOURS

Include verruca, clavus, and icthyosis cornea.

Verruca, a wart, is too familiar to require much description. Its structure is radiated, inorganized, and it is produced from the vessels of the skin beneath it. It is most common in young persons. It may be removed by caustics of various kinds. The milder preparations will generally succeed if persevered in.

Clavus, a corn, is a hard insensible substance, most common on the feet, caused usually by the pressure and friction of a shoe or boot. They are more common in the rich than the poor, and in females than in males. They result from irritation of the skin, which throws out the fluid to form the corn. Sometimes on the great toe a corn attains a large size; severe inflammation sets in, and ulceration has extended into the metacarpo-phalangeal joint, a disease tedious in its progress and difficult to heal. Corns may be removed by the application of acidum aceticum fortius, caustics, frequent bathing in warm water, and many mechanical contrivances, which either remove them or take all pressure off them.

Icthyosis cornea consists in the formation of horny tumours in various parts of the body. This disease is unconnected with syphilis, and does not include those horny excrescences which sometimes attend that affection. These cases are exceedingly rare.

DERMOID TUMOURS

Include lepoides, eiloides, and keloides.

Lepoides (bark-like) is a disease of the skin which produces scaly crusts or bark-like roughness of the skin, most common on the face and in aged persons. It is slow in progress, leads to ulceration, but shortens life in no marked degree. It may be removed by caustics or the knife.

Keloides (crab-like) is a disease in which there is a tumour, from which red vascular processes extend, resembling crab's claws. The red colour, however, is not present in every variety of this affection. The species are three, first, a white permanent elevation of the skin, resembling the eschar from a burn; second, a spider-like pimple on the face; third, the keloides of Alibert.

Eiloides (coil-like) is a disease in which there is an elevation of the skin in the form of rolls or coils.

occurs in scrofulous habits, is inconvenient and dangerous, but is at the same time extremely rare.

Molluscum, described by Dr. Bateman, might be classed under the head of dermoid tumours. It consists of numerous pendulous tumours, connected most with the skin of the head and face. It yields to no medicines.

TUMOURS OF THE CELLULAR MEMBRANE.

Steatoma (a wen) is a tumour which varies considerably in size, from that of a pea up to many pounds in weight, Its external surface is smooth and regular, its consistence firm; the colour of the skin is not altered, and no pain attends it; generally it is moveable under the skin and on the surface of the muscles over which it lies. Its colour is slightly yellow; it is inclosed in a cellular coat, from which processes pass into the tumour, separating it into lobules. A steatome occurring in the shoulder and neck has sometimes a softer consistence. This tumour does no harm, except by its local inconvenience. There is no remedy for it but excision.

The cellular tissue is liable to the formation of tumour, having a fibrous arrangement. Its colour is whitish, consistence firm, and texture laminated. It causes inconvenience, chiefly by its mechanical effects interfering with the free motion of the muscles.

The *painful subcutaneous tubercle* has been described as a swelling of a nerve, or at least as a tumour pressing upon a nerve. It is hard, and generally of a small size, and seldom produces any elevation of the surface. There is no discoloration of the skin, but much pain beneath it of a variable character. It is most common in the lower extremities. Sometimes inflammation attacks the part affected, suppuration and ulceration ensue, which have been known to destroy life. Generally it is not of a malignant character, but still is difficult to relieve.

MUSCULAR TUMOURS.

These are found in the substance of muscles, and are of rare occurrence. They are little evident externally, are slightly moveable in the relaxed state of the muscle, but fixed when the muscle is contracted; when operated on, a large portion of muscle requires to be removed.

Encysted muscular melanosis is very rare. The tumour formed by it, when cut into, exhibits a hard dark-coloured substance, containing a nucleus of osseous matter, surrounded by a dark-coloured fluid, inclosed in a black crust. It has not assumed a malignant character.

Scirrhous muscular tumour has been seen in the practice of Dr. Warren, it arose in the rectus muscle in consequence of a blow. After being removed by the knife, it presented a cartilaginous hardness; its colour was brownish, its texture was granular intermixed with fibrous organization, and around it the vessels were much enlarged.

Malignant melanosis is characterized by a hard tumour, internally of a black colour; the constitution suffers, and puts on the cancerous diathesis.

Fungus hæmatodes occurs in muscles, seldom, perhaps never, as a primary affection. It assumes the same character as elsewhere. There is first an irregular swelling with some pain. The swelling increases and points through the skin, which gives way, and a quantity of blood is discharged; an oozing continues till a dark-coloured fungus protrudes of considerable diameter, and elevated above the surface; frequent hemorrhage takes place, the disease extends to the neighbouring glands, and the patient dies from exhaustion. It requires removal by the knife in an early stage.

TUMOURS OF THE TENDONS.

Tendons are rarely enlarged in the form of tumours. They may be thickened by rheumatism and syphilis; but a tumour of these is generally the result of powerful muscular action. Such tumours are hard, generally not painful, insensible, and difficult to remove. They may injure the motion of a limb by their mechanical pressure.

PERIOSTEAL TUMOURS.

The periosteum becomes thickened from the effect of blows, rheumatism, and syphilis; but this does not come under the character of periosteal tumour.

Tumours or excrescences of a permanent nature are sometimes produced from the condyles of the humerus and os femoris. They somewhat resemble exostosis, but are not of a bony nature. They are semitransparent, have a cartilaginous aspect, and occasionally contain a little earthy matter. They differ from periosteal exostosis in the following respect, viz., they are diffused, irregular, and moderately hard, and may diminish and disappear. They sometimes occur on the dorsum of the foot, from the pressure of the boot, and require removal by the knife.

OSSEOUS TUMOURS.

These are divided by Sir A. Cooper into periosteal and medullary.

Periosteal exostosis is characterized by hardness, regularity, slow growth, and want of sensibility. The point of attachment is narrow, resembling a neck to the tumour. If removed by operation, they are very prone to be reproduced, unless a considerable portion of the bone from which they arise, be removed.

Medullary exostosis arises in the cancellous structure of bones, principally the long bones, and in scrofulous subjects. It first produces lameness, then an uniform swelling of the affected part, which increases very rapidly.

The skin is only discoloured by the veins which become enlarged. The surface of the tumour feels hard, but on careful examination a number of soft spots may be found. In a short time ulceration takes place, and a quantity of watery pus with white flocculi, is discharged, the constitution is soon worn out by the disease, unless it be removed by amputation.

Maxillary exostosis of the spongy texture. This disease affects more frequently the upper jaw, *periosteal* exostosis the lower. It is a hard tumour of a rounded form, appearing on the outer surface of the bone, producing prominence of the cheek, if it is large. It is not discoloured nor painful, enlarges rapidly in young subjects, and often begins in the bottom of an alveolar cavity. It may be mistaken for the vascular tumour of the alveoli; mechanical removal is the only effectual remedy.

Osteo-sarcoma (osteo-medullary tumour of Mr. Travers). This is a hard tumour which arises from periosteum or bone. In external appearance, it has a firm consistence, a rounded form, and seems to bury and involve the bone from which it is derived. Its colour varies from that of the skin to a red, and it exhibits enlarged veins over its surface; when it acquires a large size it becomes more elastic and soft; the pain attending it is not acute, but of an aching character. The surface is tuberculated, which is characteristic of it; the inequalities are caused by masses of unequally thickened periosteum. In its interior it does not present bony plates or cartilaginous septa. The constituents of the tumour are the bone on which the tumour is placed, the periosteum, the medullary fungus contained in the periosteum, and a fluid in some cells which are found in the centre. It appears to take its origin chiefly from inflammation of the periosteum. This disease generally does not affect the system at large by any malignant quality, and may with propriety be removed by the knife; if left to itself, ulceration will ensue, the integuments slough, and the patient is gradually exhausted. In some cases the lymphatic and other glands have fallen into a fungoid degeneration.

It is distinguished from exostosis by wanting its hardness;
common periosteal tumour, by its regular form and greater size;
scirrhus, by being closely connected with the bone;
medullary exostosis, by wanting the basket-like surface occasioned by the layers of bone and membrane.

GLANDULAR TUMOURS.

These include tumours of lymphatic, secreting, mucous, and sebaceous or oleaginous glands. Tumours of *lymphatic* glands may be divided into scrofulous, scirrhous, and fungoid.

Scrofulous tumours, are simple enlargements of the glands, most frequent in the neck, groin, and armpit; they have an ovoidal form, are in clusters, seldom painful till they pass into a state of suppuration ; they then redden, become painful, break, and discharge a flocculent cheesy-looking matter, and continue to discharge for a long time.

Scirrhous lymphatic glands may be divided into non-malignant and malignant. The non-malignant scirrhous tumour is globular, hard, not discoloured nor painful ; its hardness is permanent, and it steadily increases in size, generally single, sometimes double, and even clustered, as in the axilla. On examination, the tumour is covered with one or more coats formed by the surrounding cellular tissue and producing a cyst. The interior presents a white firm centre, from which matter of the same kind radiates towards the surface ; and between these, a reddish substance resembling the healthy structure of the gland. The term scirrhus is used here merely to express their hardness ; for they are not malignant and might be left alone, were it not for their mechanical inconvenience.

Malignant tumours of lymphatic glands admit of a division into scirrhous malignant and fungoid. The *scirrhous* malignant disease begins with glandular induration, with much hardness but little soreness or pain at first ; after some months, pain is perceived, other neighbouring glands become affected, the patient begins to lose flesh and strength, the glands become much enlarged, the pain increases and particularly affects the back ; if the tumour is situated in the groin, watery effusion takes place in the thorax, abdomen, and extremities, and the patient gradually sinks. Sometimes the original tumour ulcerates and produces a painful, unsightly sore.

The *fungoid* disease of lymphatic glands is less frequent than the scirrhous. This is very deceitful and insidious in its progress; at first it is small, has a soft consistence, and its connexions are not precisely definable; without colour at first, it sometimes becomes afterwards of a livid red, and may be mistaken for an abscess. If cut into, nothing but bloody water or some blood is discharged; if extirpated, it is likely to appear again in the cicatrix, and gradually affects other glands and the large organs.

This disease is said to be distinguished by the *softness* of the tumour, its tendency to *discoloration*, its early influence on the constitution, and the extent to which it affects the lymphatic system. An operation may be tried in the early stage, but is seldom of much avail, as the disease is one which affects the body generally, and is sure to manifest itself in several parts.

TUMOURS OF SECRETING GLANDS.

These are more frequent in the mamma, testis, and salivary glands. Carcinoma is very frequent in the breast, rare in the testis. Fungoid disease, on the contrary, is more common in the testis.

TUMOURS OF THE BREAST.

These are deserving of great attention, as many of them, not malignant, are often mistaken for cancer. The most valuable remarks upon these are from Sir A. Cooper and Mr. Travers. The former author divides them into malignant and non-malignant: of the latter, seven species are described, and are, 1, hydatid disease; 2, chronic mammary tumour; 3, cartilaginous osseous tumour; 4, adipose tumour; 5, the large pendulous breast; 6, scrofulous swelling; 7, the irritable tumour.

Hydatid tumour. (Vide p. 61.) In its early stage it is distinguished from scrofulous tumour by its greater hardness, and from scirrhous by more softness. In its advanced stage, it is distinguished by the globular elevations on its surface, by its great size and freedom from pain.

Chronic mammary tumour. (Vide p. 61.)

Cartilaginous or *osseous* tumour is very rare, and is known by its extreme hardness, absence of much pain, and slow progress.

Scrofulous tumour occurs in early life, before twenty-five years of age, and is connected with a general scrofulous diathesis. The tumour is large, irregular, indistinct, not painful, varies in size, increasing and diminishing at different times, it rarely suppurates. Surgical operations are not requisite: it requires mere constitutional remedies.

Irritable tumour, occurs before the middle age in delicate and irritable habits. The tumour is not large nor well defined, but painful; sometimes accompanied with general swelling of the breast and fever, which subside and leave the original tumour. It is not malignant.

The *adipose* tumour occurs in fleshy healthy females. It is distinguished from the hydatid and scirrhous breast by its great size, elasticity, freedom from acute pain and regular surface; it only requires operation from its size. The large pendulous breast tells its own story, and requires mechanical support.

The malignant diseases of the breast are two, viz. scirrhus and fungus hæmatodes, also named encephaloid tumour, or soft cancer.

Fungoid disease of the breast is not often seen. It is a disease of early life and a scrofulous habit; it begins with a soft elastic tumour, which increases rapidly, approaches the surface, points like an abscess, and on being opened, discharges a thin bloody fluid. A fungus shoots out from the wound, which sometimes bleeds; the patient's health becomes impaired, the lungs become often diseased, the abdomen swells, the limbs become œdematous, and the patient dies with general dropsy; the disease is constitutional and incurable.

Fungoid disease is most likely to be mistaken for hydatid breast, but may be distinguished as follows:

FUNGUS.	HYDATID BREAST.
Often preceded, always attended with constitutional derangement; appears composed of two or three large masses somewhat rounded; superficial veins much enlarged; adheres to the pectoral muscle.	General health not obviously affected; presents a number of regular eminences of a globular form; superficial veins not much enlarged; unattached and pendulous.

Carcinoma or cancer of the breast generally occurs about the age of forty to fifty, occasionally before or after those periods. It seems to be in some degree hereditary, and at all events is a constitutional disease. The tumour is at first of a small size, increasing with variable rapidity; found most frequently in the axillary side of the breast, very hard, moveable at first, afterwards less so; is accompanied with lancinating pains, sometimes severe, increases gradually, contracts adhesions with the skin, produces distortion and drawing in of the nipple, ultimately causes a redness of the skin, followed by ulceration and a discharge of fetid matter; the edges of the ulcer turn out, bleeding occurs, sometimes profusely, from ulceration of the vessels. It is accompanied with enlargement of the axillary glands, swelling of the arm, difficulty of breathing, cough, abdominal pains, dropsy of the abdomen, and thorax, and fragility of the bones. The patient generally dies from disease of the internal organs.

TUMOURS OF THE SALIVARY GLANDS.

These glands are subject to enlargement, and the submaxillary most frequently.

The parotid gland is liable to two species of induration, one, more common in the lymphatic glands about it; the other, a genuine induration of the parotid itself. The tumour of the lymphatic glands may be distinguished by its smoothness, roundness, hardness, and freedom from pain; it often suppurates, and sometimes may require extirpation.

Scirrhous induration of the parotid gland begins deeply and is attended with pain from the pressure on the neighbouring parts; it also interferes with deglutition, sometimes ulcerates, and has killed by the pressure on the large vessels. The only remedy for it, is extirpation, an operation which few would like to venture upon, on account of the important relations of this part.

The *submaxillary* gland is often enlarged from cold, sore throat, measles, but which easily subsides. Scirrhus of this gland is distinguished by its size, hardness, and pain, gradual increase, and impediment to deglutition. This disease requires extirpation by the knife ; the sublingual glands in some few cases have been affected with scirrhous enlargement.

TUMOURS OF THE THYROID GLAND.

This gland is liable to two kinds of enlargement, one named goitre, the other permanent scirrhus.

Goitre or *bronchocele* is a smooth soft tumour, not discoloured, not tender nor painful, causing little inconvenience except from its size.

Scirrhous thyroid. This is a hard tumour of a part of the thyroid, which grows slowly and is not troublesome for some years. Increasing in size and hardness, it becomes painful, compresses the trachea, œsophagus, and vessels of the neck, and produces difficult respiration. Sometimes it ulcerates, forms a cancerous sore, and becomes fatal. It does not yield to medicine, but requires a surgical operation for its removal ; and which is one of the most dangerous that can be attempted. The common carotid of the affected side requires to be tied before the operation can be proceeded with.

TUMOURS OF THE TESTIS.

The best account of these will be found in Sir A. Cooper's Work on Diseases of the Testicle.

They may be divided into the non-malignant and malignant. The non-malignant tumours are enlargement from common syphilitic or scrofulous inflammation, the hydatid testis, and chronic enlargement.

The malignant, are fungoid and scirrhous testis ; to which may be added cancer of the scrotum.

These have been already noticed in the present work, (p. 141-3), with the exception of Chimney-sweepers' cancer, which is, however, a disease of the integuments. This begins with a warty excrescence on the scrotum ; this increasing becomes sore and ulcerates, and the ulcerated surface is elevated. The cellular tissue becomes diseased, the glands in the groins swell, and the disease, if left to itself, soon terminates the life of the patient. If removed early, the disease may be prevented extending to the deeper parts.

TUMOURS OF MUCOUS GLANDS.

Under this head are included those tumours which are connected with, or dependent upon a diseased state of the numerous glands which open upon the surface of the mucous membrane.

Cancer of the Lip. (Vide Cancer.)

TUMOURS OF THE TONGUE.

Chronic enlargement of the papillæ and mucous glands, sometimes occurs, but disappears in a short time if the source of irritation be removed.

Cancer of the Tongue. (Vide p. 55.)

TUMOURS OF THE TONSILS.

The tonsils are liable to scirrhous induration; but which is not prone to run into the character of true cancer.

Simple chronic enlargement has been spoken of already, (p. 56.)

SCIRRHUS OF MUCOUS GLANDS OF THE CARDIAC ORIFICE OF THE STOMACH.

This is attended with difficulty and pain in swallowing, immediate rejection of the food; pain in the epigastric region, and when the disease is advanced, tenderness and sensible tumour in this region. The affected part is found to be much thickened and indurated, and presents spots with an appearance of ulceration.

SCIRRHUS OF THE PYLORIC ORIFICE.

In this there is no difficulty of swallowing, the vomiting is less frequent, the ejected matter has a dark colour, there is a sensible tumour often, larger, lower, and more on the right side of the abdomen. It is more common than the disease at the cardiac orifice. The only remedy which relieves the sufferings much is opium in its various forms.

The glands of the intestinal canal will also sometimes become affected with scirrhous disease, produce symptoms of dyspepsia, and gradually emaciate and wear out the patient.

Scirrhous stricture of the rectum probably takes its rise in the glands of this part of the intestinal canal.

TUMOURS OF THE UTERUS.

The uterus is very subject to organic disease, most commonly after the age of forty. The mucous glands of the os uteri are subject to various kinds of induration and tumefaction, vesicular, papular, and scirrhous, arising from scrofulous, venereal, and cancerous affections.

Scirrho-cancer of this part begins with induration of one of the labia of the os uteri, consisting of a number of irregularities, probably enlargements, of the mucous glands; the disease is generally first known in the state of ulceration, which is accompanied with an offensive bloody discharge and shooting pain. In this stage the os uteri is enlarged and hard, and presents great irregularities and scirrhous tubercles of various forms and sizes. The symptoms gradually increase; the stomach and intestines become affected and the patient is by degrees worn out.

Cauliflower scirrhus of the os uteri is a tumour which gradually fills the vagina, and presents many of the symptoms of the former disease.

The *fleshy tubercle* of the uterus grows to a large size, forming a single or more protuberances. It is not painful, but becomes so large sometimes as to be easily felt in the abdomen. It does not affect the health much; there is a feeling of bearing down, and some difficulty in passing the fæces.

Fibrous tumour of the uterus consists of an organized mass in the cavity of the uterus. It has a whitish colour, elastic consistence, and a fibrous texture. This forms without pain; there is suspension of the catamenia; the tumour is subject to changes in size, and in some cases has been supposed to disappear. It is not of a malignant character.

FUNGOID TUMOUR OF THE BLADDER.

This is first characterized by a discharge of blood with the urine, scanty in the commencement, but gradually increasing in quantity, till it becomes quite exhausting; very little pain attends it; there is a frequent desire to pass the urine, and sympathetic irritation of the rectum with constant desire to go to stool; the disease becomes fatal by the constitutional irritation which it induces.

CANCER OF THE PENIS.

This disease first appears in the form of a warty excrescence on the glans or prepuce. It may be distinguished from the venereal wart, by being more fleshy, and accompanied with a stinging pain. The crust being removed the sore does not heal, but extends to the surrounding parts and produces a frightful fungous excrescence covering the glans; the glands in the groin soon become affected; the disease extends, and affects the system at large, and soon exhausts the vital powers.

The only remedy is removal of the disease by the knife in its early stage.

TUMOURS OF MEMBRANOUS TEXTURES.

Tumours of mucous membrane are most common in those parts which approach the external apertures, as the rectum, nostrils, and vagina.

Hemorrhoidal Tumours have been treated of, (p. 151.)

Tumours of the mucous membrane of the nose are named polypi; they have been described, (p. 52.)

FIBROUS TUMOUR OF THE ANTRUM.

This disease is comparatively rare; it is of slow growth, begins without pain, and only causes pain by pressure on the surrounding parts. It does not force out the bones of the face like the fungoid disease of the antrum, but rather encroaches upon the orbit and nose; it has a firm consistence, brownish-white colour, moderate vascularity, and does not bleed freely.

FUNGOID TUMOUR OF THE ANTRUM.

This disease is malignant; it begins with uneasiness in the nose, the nostril of the side affected becomes obstructed and there is a feeling like polypus; there is a red tumour in the nostril, which if lacerated pours out blood, pain is experienced; then an offensive ichorous discharge emerges from the nose, the face swells, the maxillary bone covering the antrum is protruded, and there is great deformity; sometimes, the palate bone is depressed, first towards the mouth, the molar teeth drop out, and there may be a discharge of blood, which relieves. Fistulous openings soon appear, the throat may become obstructed from posterior extension of the disease, and the eye may be protruded or buried in the tumour; left to itself, the disease is always fatal. Extirpation of the diseased part affords the only hope of prolonging life, by an operation which in this country, of late years, has been many times performed, especially by Mr. Liston.

FUNGOID TUMOUR OF THE UTERUS.

This is likely to be mistaken for the cauliflower excrescence of the uterus, which, however, generally commences in the os uteri, and is attended with more pain. Fungoid tumour has a polypous form, and begins in the cavity of the uterus; the tumour sometimes protrudes so as to fill the vagina. It has an irregular surface, bleeds on examination, and is frequently attended with an offensive discharge. There are two varieties of it, one malignant, the other not, but very similar in their symptoms; the application of the ligature gives the best, although feeble hopes of success in the treatment.

TUMOURS OF SYNOVIAL MEMBRANE.

Tumours or swellings of this membrane have a soft consistence, producing no discoloration; when large, they give some sensation of fluctuation. Not painful on pressure, but produce inconvenience by weakening the muscular action of the part. These swellings are brought on by contusions or strong muscular efforts. The *House-maid's knee* is of this character.

A ganglion on the back of the hand causes troublesome symptoms, amongst which is a weakness of the extensor muscles. It has been removed by the sac being ruptured by a smart blow; or the sac may be opened by a lancet, and the wound healed by the first intention.

ENCYSTED TUMOURS.

These are understood to be tumours in which the contents must be of a different texture from the sac, and not of a solid consistence. These contents vary in consistence, from that of a thin liquid to that of soft cheese,—hence the old names of itheroma and meliceris: itheroma meaning an encysted tumour, with a thick pap-like substance; meliceris, one containing a fluid as thick as honey, or honey and wax mixed.

These tumours may exist in various textures; they vary much in form, size, and organization. The encysted tumour of the eyelid appears more like a diseased sebaceous gland: it may sometimes be dissipated by frequently bathing the eye with water. If they enlarge, they may be dissected out. The black specks often seen on the face, are the orifices of the oleaginous glands. On pressing out the concrete oil, the spot disappears. The encysted tumours of the scalp and back are of the same nature: their contents are soft, and often of a peculiar offensive odour. The cyst is generally soft, and yields easily. They are not malignant, but will sometimes cause inflammation and sloughing of the surrounding parts, a process which nature sets up to remove them.

They may be easily dissected out with the knife, and every portion of the sac should be carefully removed. When they occur about the neck, their extent is less defined, and their removal is often attended with considerable trouble.

TUMOUR OF THE OVARIUM.

There are two varieties of the ovarian tumour, viz. scirrhous and encysted or dropsical. The scirrhous enlargement is of a destructive character, injuring the health and cutting off life prematurely. An operation for its removal has been performed in a few cases; and, contrary to expectation, some have recovered from it. The danger attending it, however, is so great, that the surgeon is hardly warranted in ever attempting it. The tumour is hard, smooth on the surface, with a few projections, is free from pain, and contains no fluid.

The dropsical ovarium attains a large size, but does not generally disturb the health much, except by its mechanical effects. It is usually composed of a number of cells or cysts containing a thick, brownish, ropy fluid, and in many cases hydatids: consequently, less benefit results from tapping than might have been hoped for.

ON SCROFULA.

The term scrofula is applied to a morbid state of the human body, which develops diseases of a peculiar nature in various tissues and different periods of life. Scarcely any part of the body is free from its ravages, still, it shows itself more in glandular than in other parts, and is more frequently noticed in the early periods of life. Scrofula is considered to be hereditary, but not exclusively so, as it will show itself in the progeny of healthy parents, whose frames exhibited no traces of it. A scrofulous constitution is generally observed to exist in those who have a delicate, fair skin, light hair, blue eyes, red eyelids, thick lips, prominent rosy cheeks, and who rather carry with them the appearance of good health: it is also met with, but less frequently, in persons with dark hair, dark eyes, and dark complexion. There is no doubt that a scrofulous habit may be induced by bad living, exposure to cold, and all those agencies which disorder the constitution, and that by care children born of scrofulous parents, may be rendered free from the effects of this disease.

The most general and distinctive marks of its nature are the deposition of a peculiar matter in the different tissues resembling white crumbled cheese mixed with a thin yellowish fluid, and ulceration of a slow troublesome character which is much indisposed to a healing process.

We shall mention in detail a series of diseases in which scrofula has a predominant or partial influence. Some diseases of the scalp of children assume a scrofulous appearance, and porrigo in its various forms is more common in scrofulous persons than others, and receives much benefit from the use of those remedies which relieve scrofula elsewhere.

The eye is subject to several modifications of scrofula which have been noticed under Diseases of the Eye. The eyelids are very prone to chronic disease of this kind, after an attack of small-pox; about the face also, we meet with scrofulous enlargement of the alæ nasi and lips, which require no specific attention.

In the neck, the lymphatic glands are very liable to the deposition of scrofulous matter, which leads to suppuration and to extensive ulceration. This is healed with much difficulty, and generally leaves behind it extensive marks of its ravages in the form of corrugated unsightly cicatrices. Scrofulous individuals, if minutely examined at the meridian of life, will often exhibit such marks, although they are anxious to conceal them, as if the disease would cast a reflection upon them. When enlargement of these glands is first noticed, there is no redness and little pain, but enlarging by degrees they approach the surface, which becomes red and inflamed; and by the assistance of ulcerative absorption the surface gives way, and purulent, with the peculiar scrofulous matter makes its escape: subsequently the same process ensues in other glands, and the ulceration extends over a large portion of the integuments, produces deep sores, with ragged edges as if bitten, partially covered with a whitish matter somewhat like lymph, and presenting a few flabby feeble granulations. The treatment which we have found most successful in these cases has been the application of the cataplasma conii to the sore; administer iodide of potassium in doses of from one to three grains three times a day, with two or three grains of the extract or pulvis conii, attending at the same time to the state of the bowels, which is best regulated by pulv. rhei with magnesia, and recommending plain, wholesome, digestible food. In some cases the iodide of iron has produced the best effects, but is generally too stimulating and irritating for children. Such sores have been treated with nitrate of silver and sulphate of copper, both in strong and weak solutions, and occasionally with success. There is favorable testimony of the use of a weak solution of sulphate of copper, in healing scrofulous sores. Mercury as a general remedy is injurious in scrofula, and should only be used as an alterative or mild stimulant to the biliary secretion, and to promote (which it appears to do sometimes) the absorption of those remedies which, introduced into the blood and tissues, induce a healthy action.

Scrofulous, tedious ulceration of the throat sometimes follows syphilis. Here mercury is of no avail and may be even mischievous: most benefit results from the administration of iodide of potassium with decoction of sarsaparilla, with which free iodine or iodide of iron in small doses may be combined.

The breast of the female has already been mentioned as liable to scrofulous enlargement; and when inflammation attacks this structure during suckling, abscesses will form, and numerous sinuses will be produced, which are difficult to cure. Bland emollient poultices are most suitable, and constitutional remedies are at the same time requisite.

Tubercles in the lungs are looked upon as a form of scrofulous deposit; both on account of their progress, mode of formation, and appearance, and because of being more common in scrofulous individuals. The mesenteric glands are often diseased in children; they become enlarged, the tubes passing through them, are obstructed, and consequently the nutritious matter of the chyle does not find its way into the circulation; hence we find wasting of the body generally, but with a tumid abdomen, a condition which is named *tabes mesenterica.* On post-mortem examination, we find the mesenteric glands much enlarged, and when cut into, they exhibit the curdled flaky substance, which is characteristic of scrofula. In these cases, iodine in its various forms is likely to be of service, and hydrargyrum cum cretâ, in moderate doses night and morning, has obtained the character of an useful remedy.

The testicle is liable to scrofulous disease, as before mentioned under Diseases of the Testis.

In cases of syphilitic bubo in scrofulous subjects, the sore does not heal rapidly; on the contrary, there is a deep unhealthy wound which gives the surgeon much trouble. The most rapid mode of healing it consists in treating the system generally by preparations of iodine with sarsaparilla. Chancre in scrofulous people does not admit of the free use of mercury, but is best remedied by the medicines which have been before alluded to. I would remark here, and intend it to apply generally, that the action of iodine and its preparations is stimulating, although in various degrees; and if in feverish plethoric individuals this medicine be employed indiscriminately and harshly, it is capable of doing serious mischief.

Scrofula attacks the bones, and more especially the cancellated tissue, in which it throws out matter to fill up the interstices, and so as to cause their enlargement. By this disease synovial membranes are softened and thickened, and are converted sometimes into a gelatinous consistence. The brain is sometimes attacked by it, and exhibits large and numerous tubercles.

Scrofulous sores upon the skin show themselves in many parts of the body, frequently upon the back and shoulders, sometimes upon the arms and legs. They are very troublesome to cure, and from this circumstance have often been submitted to the treatment of empirics. The plan which I have found to succeed best has been similar to that before mentioned in cases of scrofulous ulceration in the neck; and I feel certain, if the remedies proposed be administered carefully, that better success will be found to attend them than the impatient and inexperienced could have imagined.

ON AMPUTATION.

Amputation is the cutting off a limb, or other portions of the body, as the mamma, penis, &c. Amputation is divided into the *primary* and *secondary*. *Primary* amputation is that performed immediately, or as soon after the receipt of an injury, as the collapse consequent upon the injury has gone off.

Secondary amputation is that in which the operation is delayed until after the fever, supervening on an injury or disease, has subsided.

The following cases call for primary operation: Severe compound fractures, in which the bones are much shattered, and the soft parts are extensively destroyed, particularly if the principal vessels of the limb are injured —Extensive, contused, and lacerated wounds, destroying the muscles and integuments of the limb, as of the calf of the leg—Gun-shot wounds, which have carried away part of a limb, and have left an irregular torn wound.

Secondary amputation is performed in cases of *mortification* succeeding a compound fracture, and caused by the local injury, or proceeding from other causes, such as exposure to cold, &c.—*Diseases of the joints*, as scrofulous and other affections of the knee, ankle, or other large joints—*Exostosis*—*Necrosis*—*Large aneurisms*—*Malignant tumours*—*Extensive sloughing* of the integuments, as in erysipelas, and from burns and *large ulcers*.

Amputation may be performed by the circular, double-flap, or single-flap operation. The circular operation is in general preferred in the amputation of the thigh, of the leg in its upper half, of the arm, and of the upper half of the forearm. The double-flap operation is preferred in amputation of the lower part of the leg and forearm. The single-flap operation is seldom resorted to, unless in cases where a portion of the limb is destroyed on one side, and the flap can be made from the opposite one, so as to avoid the removal of the limb above the injured part. The double-flap operation is preferred by some to the circular, as it is more rapidly performed, and forms a better stump. The principal objections to it are the greater extent of surface divided, and the consequently greater pain given to the patient; the large extent of cut surface exposed, the oblique direction in which the vessels are divided rendering their being tied more difficult, and when tied more liable to secondary hemorrhage. We shall illustrate these several operations, and the principles that should guide us in their performance, by selecting the amputation of the thigh in the usual situation, namely, at the junction of its middle and inferior third, or a hand's breadth above the knee-joint, and describe first the circular amputation of the thigh.

The necessary examination of the state of the thoracic and abdominal viscera having been found satisfactory, the patient is placed, supported by pillows, on a table of sufficient height. Any hairs should be removed from the thigh, before commencing the operation, as, if left, they cause serious annoyance by the sticking plaster adhering to them during the after treatment. The patient should then be brought towards the edge of the table with the limb projecting beyond it, the sound foot resting on a small stool or chair, while the diseased limb is supported in the hands of a careful assistant, who kneels in front of the patient for this purpose. The tourniquet is now applied around the thigh at the junction of its upper and middle thirds, and made secure, the pad and instrument being placed directly over the course of the femoral artery. This instrument, although the best adapted to the purpose, is liable to two objections: first, it prevents the retraction of the integuments after having been divided; secondly, it stops by its circular pressure the return of the venous blood, by which a large quantity of blood is always lost; when it is desirable that this should be avoided, the artery should be compressed, where it crosses the horizontal ramus of the pubes by means of a key, or the handle of a tourniquet covered with lint. This method is also to be preferred in amputations high up in the thigh. To prevent the effect of the tourniquet in arresting the retraction of the integuments, these should be drawn upwards, as much as possible, previously to its being applied. The circulation having been commanded, the operator stands on the right side of the patient, passes the right hand under the thigh to be removed, and holding the point of the knife in the left hand, drops it into the right; the knife is now to be carried round the limb from heel to point, and the integuments divided down to the fascia, or, as Mr. Guthrie advises, through the fascia, by which means the integuments retract more freely. The integuments, if not sufficiently retracted, are now to be dissected upwards, to the extent of about two inches, and turned back so as to leave room for the further application of the knife. The muscles are now to be divided down to the bone, or the superficial muscles may be first divided, and then the deeper-seated ones close to their retracted extremities; the former having been found to retract more freely than the latter, in consequence of their attachment to the bone. Should an abscess be opened into, as occasionally happens in amputating a limb, the cyst of the abscess should be dissected out as far as possible, and the lodgement of matter prevented, by proper application of bandages and compresses. The retractor is now to be applied, and the soft parts withdrawn. The bone being freed from any muscular fibres remaining attached to it (or these even detached to the extent of one or two inches), it is now to be sawn through, and the limb removed. During the sawing of the bone the assistant who supports the limb is to be careful to hold it steadily, and in the proper position; if raised too much, the saw will become locked, and if, on the contrary depressed, the bone may become fractured before completely sawn through. The arteries are now to be secured; and first the femoral: it is found on the inner side of and close to the bone, and may be discovered, but with some difficulty, from its retracting into the tendinous canal, commonly called Hunter's canal; if so, the canal should be slit open, and the artery withdrawn and secured with the ligature; this being applied a short distance above its cut extremity. In applying the ligature, care should be taken that no branch is given off, a short distance above the point at which the vessel is tied, as otherwise, hemorrhage may proceed from the branch. This, if it exist, should be at once secured, or the femoral artery tied above its point of origin. The tourniquet may now be loosened, and all the bleeding arteries secured, a warm sponge being applied to the wound, and some moderate stimulants given to the patient to encourage the bleeding, and prevent the necessity of opening the wound after the stump has been dressed and the patient put to bed. One end of each ligature is to be cut short and the other brought out at the most depending part of the wound. The practice of cutting the ligatures short and healing the stump over them is now nearly abandoned, as such proceeding is found to be followed by greater irritation, and exposes the patient to the opening of the wound at a future period. When the patient is faint, and the arteries cannot be discovered, it is better not to close the wound for some hours after the operation. Should the femoral vein bleed, a compress of lint should be applied to its extremity, and retained there for a short time, when the bleeding will cease. The same practice is to be adopted in cases of bleeding from the wound itself. Any nerves or tendons that project should be cut short; the edges of the wound are now to be brought together, and retained in apposition, by means of strips of adhesive plaster or one or two points of suture. The sutures are objectionable from the greater irritation they produce, and should not therefore be used, if adhesive strips can be applied so as to answer the purpose. The stump is now to be covered with a fold of lint wet with a cold evaporating lotion, and supported by means of a roller applied from above downwards, so as to support the soft parts, and favour the covering of the end of the bone. Much difference of opinion exists, as to the direction in which the edges of the wound after amputation should be brought together. Some prefer that from before backwards, as this affords a free exit to the discharge from the stump. Others object to this, as the posterior part of the wound is made to gape by the pressure of the stump on the pillow, and as the cicatrix is ever afterwards exposed to pressure from the end of the bone; these, therefore, prefer uniting the wound in the transverse direction in which the cicatrix is soon drawn by the action of the flexor muscles behind the extremity of the bone, and thus preserved from injury. The wound having been dressed, the patient is to be placed in bed, with the stump supported on a pillow of moderate height, and the tourniquet applied loosely round the limb, as a precautionary measure.

In a favorable case of amputation of the thigh, some local inflammation and constitutional disturbance take place on the second or third day, which is soon followed by an adhesion of the edges of the wound by the first intention, except where the ligatures hang out, for some suppuration generally takes place at this point. The ligatures separate between the tenth and twenty-first days, varying according to the size of the artery tied, that on the largest artery being the longest in coming away, and vice versâ. At the end of the third or fourth week, the patient is sometimes enabled to leave his bed. In such favorable cases the wound may be dressed, for the first time, on the third or fourth day after the operation, and after this every second day until healed.

It rarely happens that amputation of the thigh proceeds so satisfactorily to its final termination. Many unfavorable symptoms generally arise in the course of its treatment. They may be enumerated as follows:

1st. *Starting of the stump.* This is caused by the spasmodic twitchings of the divided muscles. It is treated by the administration of an opiate, and the application of pressure on the stump, by means of a bandage or the hands of an assistant.

2d. *Secondary hemorrhage* may appear in a few hours after the operation, as soon as the patient shall have recovered the immediate shock of its performance, and the circulation becomes restored. The bleeding generally proceeds from some of the smaller arteries having been left untied, or may come from the femoral itself, when the ligature has not been properly applied. If profuse, the wound should be opened again, the coagula removed, and the bleeding vessels properly secured. The stump may be again dressed as before. Secondary hemorrhage may occur on the fifth or sixth day from sloughing of the wound or the artery tied. If the bleeding cannot be restrained by pressure and styptic applications, the femoral artery should be tied in Scarpa's triangle. It may also occur about the period of the separation of the ligature, from the want of union in the artery. The same practice is to be adopted in this case.

3d. *Violent inflammation* sometimes attacks the stump, commencing within twenty-four hours after the operation, and reaching its height often so early as the third or fourth day. The stump becomes swollen, red, and painful, and is increased in temperature, and general fever sets in. The bandages and dressings should be removed, the lips of the wound, which are merely agglutinated together, opened, and the cavity of the stump cleansed of the coagula and unhealthy discharge which it contains. A number of leeches should now be applied, the stump be fomented, and then enveloped in a cataplasm or water dressing, the lips of the wound being supported by one or two strips of adhesive plaster, aided by bandages loosely applied. The antiphlogistic regimen is to be strictly adhered to, if not contra-indicated by the weak state of the patient.

4th. *Erysipelas* may also attack the stump.

5th. *Sloughing*, or *hospital gangrene*.

6th. *Protrusion* of bone, forming a conical stump, and terminating in exfoliation. This is an exceedingly troublesome, if not dangerous symptom. It is generally caused by sufficient soft parts not having been left in the operation to cover the end of the bone, by starting of the stump, or by sloughing, or profuse suppuration from it. When the bone projects much, the protruding portion should be removed with the saw. When the projection is moderate, it may be left to nature, which accomplishes the cure by the exfoliation of the bone, a complete ring of which comes away.

7th. *Painful affections of the nerves,* from their extremities being included in the cicatrix, or exposed to pressure from the end of the bone; when anodyne applications fail to give relief, the nerves should be removed.

Amputation may prove fatal from the shock of the operation, secondary hemorrhage, violent inflammation, and erysipelas of the stump, sloughing, or hospital gangrene, mortification, or from some of the internal organs, particularly those of the thorax or abdomen, being diseased.

If the stump be examined some months after the operation, a cicatrix, corresponding to the wound, will be found in the integuments; this is small, and approaches to a circular shape; the surrounding skin is puckered or drawn into folds. Between the skin and end of the bone a bursa exists. The muscles are retracted and wasted near the extremity of the stump. The vessels are obliterated as high up as the nearest anastomosing branch of consequence. The nerves are expanded at their extremities, and present a gangliform appearance. The end of the bone is expanded, its edges rounded off, and its medullary canal closed.

Double-flap amputation of the thigh. The patient being placed in the proper position, and the circulation commanded, the surgeon grasps the soft parts on the outer side of the thigh, and draws them outwards, passes the catlin from before backwards, through the thigh to the outer side of the femur, and then cutting downwards and outwards, makes the external flap. By a similar method observed on the inner side of the bone, the internal flap is formed. The flaps being now held back, and the retractor applied, the bone is to be sawn through and the operation completed, as in the circular amputation.

In the single-flap amputation, the flap is made in a similar manner to the preceding, excepting that we are obliged to form it from that portion of the limb which has escaped injury. In addition to the objections already brought forward to the flap amputations, the arteries may be divided twice, namely, at the introduction of the knife and in forming the flap; a careful examination will therefore be necessary to ascertain that this has not occurred.

Amputation of the leg. The leg may be removed in its upper, middle, or lower third. Amputation in the upper third is in general to be preferred, as the stump formed by it is found to be most useful, the portion of the limb left in the other amputations projecting much posteriorly, to the great annoyance and inconvenience of the patient. When, however, the patient requires his leg for ornament as well as for use, either of the other situations may be selected.

Amputation in the upper third of the leg or below the knee:

Apply the tourniquet on the inner side of the thigh, at the junction of its middle and inferior third, so as to compress the femoral artery before it perforates the tendon of the triceps. Make a circular incision through the integuments about six inches below the patella, reflex back the skin, cut through the muscles by a second circular incision, pass the catlin between the bones, so as to divide the soft parts in the interosseous space, and saw through the bones, taking care that the fibula is the first divided. Dress the stump as in the circular amputation of the thigh, the line of incision corresponding to the long axis of the limb. The removal of a portion of the anterior edge or spine of the tibia will be found useful by preventing the irritation of the skin, so likely to be induced by the projecting edge of the bone. Some have recommended also the removal of the head of the fibula, this is highly objectionable, for in doing so, the knee-joint will most probably be opened into, and the insertions of the biceps and the external lateral ligament are destroyed.

Some difficulty is occasionally experienced in tying the anterior tibial artery, from its divided extremity retracting through the interosseous space. The artery may be easily exposed by dividing the interosseous membrane. The leg may be amputated through the lower part of the tubercle of the tibia; sufficient attachment will be left to the ligamentum patellæ to preserve the action of the extensor muscles.

Amputation in the middle third of the leg may be performed by the circular amputation, or by making a flap from the posterior part of the limb. Amputation in the lower third is in general performed in the latter way. The flap operation is performed as follows:

The limb being placed nearly in the horizontal position, with the fibula upwards, the catlin is pushed through the leg, from the outer to the inner side, close to and behind the bones, and then carried downwards and outwards, so as to form the flap posteriorly of sufficient length; a semicircular incision is now made across the front of the limb, meeting at each extremity the commencement of the first wound. The integuments being dissected back, the limb is to be removed, as in the circular operation. If any tendons or nerves project, they should be at once cut short. Mr. Hey has recommended lines to be drawn on the limb, in order to guide the surgeon in forming the flap, sawing through the bones, &c.; his practice has, however, fallen into disuse.

Partial amputation of the foot. Mr. Hey has recommended a portion of the foot to be removed, in cases of accident or disease, at the tarso-metatarsal articulation. To this we are guided by the projection of the base of the fifth metatarsal bone. From this point forward, make an incision about an inch in length, then continue it forwards and inwards, across the dorsum of the foot, terminating it in front of the first tarso-metatarsal articulation, along the inner side of which a straight incision is made, corresponding to that on the outer side. Dissect back the integuments from the dorsum of the foot, and proceed to cut through the articulations; this is best done by commencing on the outer side and following the line of articulation. The joints having been opened into, the anterior part of the foot should be depressed, and a flap made from the sole, by carrying the knife forwards along the under surface of the foot. The anterior part of the foot having been removed, the arteries secured, and the tendons and nerves cut short, the flaps may be brought together and dressed.

Chopart has suggested removing part of the foot at the articulation, between the os calcis and os astragalus behind, and the navicular and cuboid bones in front. The projection of the os naviculare on the inner side of the foot guides us to the articulation. Two flaps are made, one from the dorsum, the other from the sole of the foot, as in Hey's amputation. These partial amputations of the foot are objected to by many, from the violent inflammation that frequently results from exposing so extensive an articulating surface. In Chopart's amputation there is much risk of opening into the ankle-joint. The stump, too, is not found so useful as might be imagined, as the gastrocnemii not being antagonized by other muscles, draw up the os calcis, and thus force the anterior part of the stump against the ground. Sir A. Cooper prefers the sawing through the bones without regarding the line of articulation. Partial amputations of the foot may be practised from before backwards, so as to remove one or more of the metatarsal bones, and if necessary the adjoining tarsal bones.

Amputation of the arm. The arm is amputated by the circular operation. The steps of the operation do not differ from those recommended for the removal of the thigh. The circulation is commanded by placing the tourniquet round the upper part of the arm, or by an assistant compressing the artery here with his fingers. When the extremity is removed high up, the subclavian artery should be compressed above the clavicle. When the arm is to be removed near the shoulder-joint, Mr. Guthrie recommends the following plan :

> "Two incisions are to commence one or two fingers' breadth below the acromion, and the inner one is to be extended directly across the inner side of the limb, till it meets the lower point of the outer wound. Without detaching the skin from the muscles, these are cut through, the soft parts are held out of the way of the saw, the bone is sawn, the vessels secured, and the flaps brought together, so as to form a line from the acromion downwards."

When amputation is performed high up, the bone is exceedingly apt to protrude from the spasmodic action of the pectoralis major muscle, so much so, that some prefer amputation at the shoulder-joint.

Amputation of the forearm. The forearm is removed in its upper half by the circular incision, as described in amputating the leg. It will be necessary to divide the fascia on each side of the limb, to prevent its constricting the stump. The sawing of the bones may be commenced at the same time, the forearm being pronated as much as possible, but that of the radius should be first completed. The line of junction of the soft parts should correspond to the long axis of the limb. In amputation of the lower half of the forearm, the double-flap operation is preferred. The flaps are formed, one from the anterior, the other from the posterior surface of the limb, by passing the catlin through the soft parts, close to the bones, and then carrying it downwards and outwards to the necessary extent. The soft parts in the interosseous space being next divided, the bones are sawn through, and the operation completed.

Amputation of the hip-joint.—Larrey's method.

The femoral artery having been first cut down upon and tied close to Poupart's ligament, a straight knife is perpendicularly plunged between the tendons of the muscles attached to the trochanter minor and the base of the neck of the femur, so as to bring out its point at the back part of the limb, opposite to its first entrance; and then by directing the knife obliquely inwards and downwards, a flap, which is not to be too large, is made of the soft parts at the inner and upper part of the limb. This flap is next drawn towards the scrotum by an assistant, and the articulation brought into view. The thigh is now abducted, the inner part of the capsular ligament divided, and the joint opened. The ligamentum teres is then cut, and the bone dislocated. The knife is next brought to the outside of the great trochanter, and an external flap formed by the soft parts, calculated to meet that made at the inside of the limb. In proceeding through the operation, Larrey secured the several branches of arteries as soon as they were divided. The two flaps were brought together and kept in this position with straps of adhesive plaster and a woollen spica bandage.

Sir A. Cooper commences his operation by making an incision first below Poupart's ligament, a little on the outside of the femoral artery. The wound is then carried obliquely downwards and outwards to the back of the thigh, about one third of the way down it, from which point the knife is carried in the opposite direction, obliquely upwards and inwards, to meet the first incision, so as to make an elliptical curve. The femoral artery being divided is immediately tied. The muscles are next cut through, the arteries secured, and the bone taken out of its socket.

Many other plans are suggested by surgeons, and are described in their works.

Amputation of the shoulder-joint. The most approved mode of amputating at the shoulder-joint is that in which a flap is made of the deltoid muscle. This is accomplished either by making a semicircular incision through the skin and muscles, commencing in front, at a short distance external to the coracoid process, and terminating behind at the posterior edge of the acromion, the incision extending on the arm as low down as a hand's breadth from the edge of the acromion; or, as recommended by Dupuytren, by raising the deltoid muscle with the left hand, while with the right the catlin is passed beneath the muscle near its origin, and the flap made by cutting downwards and outwards. The flap being raised from off the articulation, the knife is passed along the bicipital groove into the interior of the joint, and the attachments of the capsular muscles divided; the head of the bone is now forced outwards by pressing the elbow inwards, and the arm separated by cutting through the vessels, nerves, and soft parts on the inner side, or towards the axilla. Mr. Guthrie commences the first incision immediately below the acromion, and with a gentle curve extends it downwards and inwards through the integuments only, a little below the anterior fold of the armpit. The second incision outwards is made after the same manner, but is carried rather further down, so as to expose the long head of the triceps at the under edge of the deltoid. The third incision, commencing at the same spot as the first but following the margin of the retracted skin, divides the deltoid on that side down to the bone, and exposes the insertion of the pectoralis major, which must be cut through. This flap is now to be raised so as to expose the head of the bone. The fourth incision outwards divides the deltoid muscle down to the bone, when the posterior flap is to be well turned back, so as to bring into view the teres minor, and infra-spinatus passing from the scapula to the great tuberosity of the humerus. The outer and inner flaps being now raised, the head of the bone may be rolled a little outwards, the teres minor and infra-spinatus cut, and an opening made into the joint. The operation is completed as in the foregoing operation. During the amputation at the shoulder-joint the circulation may be commanded by compressing the subclavian artery above the clavicle, or by an assistant taking hold of the soft parts on the inner side of the arm previously to their division.

Amputation of the wrist-joint. The hand may be removed at the wrist-joint by making a semilunar flap of the integuments, first on the anterior, then on the posterior part of the wrist; the flaps being dissected upwards, the articulation may be opened into on the side, and the disarticulation completed by cutting through the joint and dividing the flexor and extensor tendons. Sir A. Cooper prefers this operation to that of amputating the lower third of the forearm.

Amputation of the fingers and toes. The first or second phalanges of the fingers may be removed at their articulation by making a circular incision round the finger in front of the joint, dissecting up the skin, and then cutting into the articulation; or by making a semilunar flap of the integuments on the dorsum of the finger, cutting into the articulation, and then forming the under flap by carrying the knife forwards to the necessary extent.

The fingers may be removed at the metacarpo-phalangeal articulation. The toes are almost always removed at the metatarso-phalangeal articulation. This operation is performed by making a longitudinal incision on one side of the articulation through the soft parts as far as the joint; the knife is then carried through the joint, and an incision made on the opposite side corresponding to the first. The two flaps thus formed cover the end of the bone. In this operation the head of the metacarpal bone should be removed, as by so doing, the remaining fingers are brought together more perfectly, and the hand rendered more useful, and less deformed. This operation is in general to be preferred to that of amputating at the central joint of the finger, as in this last the first phalanx which is left, interferes much with the utility of the remaining fingers, and is itself of no possible use. We see no objection to the cutting down at once on the neck of the metacarpal bone, and sawing this off without opening into the articulation. The thumb is removed with its metacarpal bone by cutting through the soft parts on the inner side down to the articulation; this is then opened into, and a flap formed on the outer side by carrying the knife close to the bone, as far forwards as will make it correspond to and cover the first incision. Any of the metacarpal or metatarsal bones may be removed with the corresponding finger, or toe, in a somewhat similar manner. Modern surgeons recommend the removal of the heads of bones, when these are shattered, as in gunshot wounds, or become diseased. The operation has met with much success, with the exception of those performed at the knee-joint.

HEMORRHAGE.

HEMORRHAGE appears as an idiopathic disease, most frequently from mucous surfaces. The schneiderian membrane of the nose is that which is most subject to it. It is here named *epistaxis*, and has been already considered under that head. The hemorrhage which interest surgeons most is that which proceeds from injured blood-vessels.

Hemorrhage from arteries is much more difficult to control than that from veins, in consequence of their greater resistance and being more directly affected by the action of the heart. Arterial bleeding is characterized by the red colour of the blood, by this fluid being discharged per saltum, and being only restrained when the vessel is compressed on that side which is next to the heart. Hemorrhage from the smaller arteries seldom gives much trouble; the application of cold to the wound or styptic remedies, such as spirits of turpentine, solution of alum, &c. or the closing of the edges of the wound will in general be found sufficient to restrain it. This is not, however, the case with the larger arteries, as, for instance, those of the leg, thigh, forearm, arm, or trunk. The size of these vessels, the larger column of blood impelled into them so much more powerfully by the action of the left ventricle, and the absence of that degree of contractility possessed by the smaller arteries, call for more active remedies to arrest hemorrhage from them when wounded. It is unnecessary to allude to the older remedies for stopping hemorrhage, such as the actual cautery, &c.: these are now superseded, except in some very rare instances, by the ligature. Let us suppose that the femoral artery has been cut across, or otherwise wounded. The surgeon should immediately compress the vessel leading to the wounded part, by the tourniquet or any other means within his reach. Having arrested the hemorrhage for the moment, he proceeds to tie the vessel. The wound, if sufficiently large, should be opened, and if not, must be dilated for the purpose, and the mouth of the bleeding vessel exposed. The artery is now transfixed with the tenaculum or taken hold of with the forceps, or if not completely cut across, the aneurism needle is passed beneath it, and the ligature applied so as to cut through the internal and middle coats and then tied firmly. Both extremities of the vessel should be secured, as otherwise the anastomosing branches will convey the blood into the lower end of the artery and the hemorrhage will return. (Vide Aneurism, for effects of the ligature on the artery and the subsequent process by which the hemorrhage is permanently restrained.)

It frequently happens, even in wounds of very large arteries, that nature alone is sufficient to stop the hemorrhage, and particularly when the wound has been of a lacerated character; thus, the arm has been torn from the trunk with but little bleeding. The means then that nature adopts to restrain hemorrhage are as follows: immediately on the artery being wounded, the blood escapes from the vessel, and becomes entangled in the surrounding cellular tissue, and thus forms an external coagulum variable as to size and shape; at the same time the artery, if cut across, contracts, and retracts within its cellular coat, which also becomes filled with blood. If the hemorrhage be profuse, the patient faints, by which the action of the heart and arteries becomes lessened, thus affording time for the more firm contraction of the vessel, and the greater consolidation of the external coagulum. A second coagulum soon forms in the interior of the artery, which is of a conical shape, the apex towards the heart and extends as far as the next anastomosing branch. After some time lymph is poured out from the edges of the wound, the coagula are absorbed, and the artery, contracting to the nearest anastomosing branch, becomes obliterated and degenerates into a ligamentous chord. Partial wounds of an artery are in general more dangerous than complete division, as the vessel is prevented from contracting and retracting. A puncture or longitudinal incision, is less likely to be fatal than an oblique or transverse one. Hemorrhage from veins is easily restrained by making pressure on the vein beyond the wound. The ligature should never be resorted to in order to restrain venous hemorrhage, except when other means are found not to succeed, as these vessels are extremely prone to inflammation of their lining membrane, a disease which is usually fatal.

ON URINARY CALCULI AND LITHOTOMY.

Urinary calculi are understood to be concretions formed and existing in the urinary passages; they have their origin in most cases in the kidneys, from which they pass down the ureters into the bladder, and remaining there acquire a very large size; some having attained a weight of from fourteen to sixteen ounces, and even more. Urinary calculi may remain in the kidneys, and are then properly named *renal:* they are accompanied in most cases with pain in the lumbar region, referred to the kidneys, some tenderness on pressure, increase of pain from violent exertion, a morbid state of the urine, which is ropy and turbid, and produces considerable deposit, according to the quality of the calculus; blood is often discharged, and there is considerable derangement of the general health. In some cases the symptoms are so obscure, that men of eminence and great practical knowledge have overlooked them, and prescribed medicines diametrically opposite to those, they would have given, had they been aware of the existence of a calculus. When they are detected in the kidneys, surgical measures are not resorted to, but endeavours are made to reduce their size, or, at least, to prevent their enlargement by suitable medicines. Thus, if there be evidence that the calculus is of the uric-acid kind, liquor potassæ, the carbonate of potash, preparations of soda, and magnesia are employed; but a preference ought to be given to the salts of potash. If the concretion consists of the phosphates and carbonates of magnesia and lime, most benefit will accrue from the administration of acids, and most particularly hydrochloric and nitric. The same remedies are indicated when deposits take place in the urine, independent of actual concretion. Not unfrequently renal calculi produce suppuration and ulceration, so as to open into the colon, through the integuments, or in the lumbar region. They may be, when large, cut down upon and removed.

Renal calculi, escaping from the pelvis of the kidney and passing along the ureters, sometimes give rise to most distressing symptoms, such as acute lancinating pains in the course of the ureters, frequent desire to pass urine, which is scanty and often bloody, pain and retraction of the testicle, and pain on the inside of the thighs. There is vomiting, and if inflammation be caused by the stone, a very quick state of the circulation. A stone descending along the ureter into the bladder may be mistaken for peritonitis: it is distinguished by the generally undisturbed state of the circulation and the absence of tenderness on pressure. The remedies for this are bloodletting from the arm, the warm bath, oleaginous purgatives, large doses of opium, and opiate enemata.

The calculus having passed into the bladder is then named a *vesical calculus*. These concretions, however, are formed in the bladder primarily in many instances, and owe their origin to several circumstances. If the urine be in a diseased state, and some of its proximate principles be rendered insoluble, they will be likely to remain embedded between the rugæ of the bladder, and will serve as a nucleus for additional deposit. The nucleus sometimes appears to be merely some thickened mucus, or a small clot of blood. Almost any foreign body is found to be soon incrusted with solid matter, which has been illustrated by pieces of metal, pipe, or bougies which have been allowed to escape into the bladder. The presence of such substances in itself produces a diseased condition of this cavity, as well as of the urine, and thus acts as a powerfully exciting cause of deposition.

Urinary calculi present several varieties, of which, about six are the most common; some are exceedingly rare, and are scarcely noticed or admitted by many authors. The best known are the following:

Calculi.	*External Character.*	*Chemical Qualities.*
1. Uric acid (most common.)	Colour, brownish-red, fawn, or mahogany. Surface smooth, sometimes tuberculated. Structure, in concentric lamellæ of a crystalline texture; has sometimes an earthy appearance.	Decomposed before the blowpipe, giving out a strong odour, and leaving only a little gray ash. Soluble in liquor potassæ, from which it may be precipitated by acetic acid, in the form of a white powder. Heated with nitric acid on a glass, it is decomposed, and by evaporation leaves a substance of a beautiful pink colour.
2. Urate of ammonia, (very rare) occurs in children.	Colour, clay-like. Surface, smooth, sometimes tuberculated. Structure, concentric lamellæ. Fracture, earthy.	Before the blowpipe decrepitates strongly; treated with liquor potassæ it evolves ammonia; it is also soluble in solution of carbonate of potash or soda, but not so the uric acid calculus.

Calculi.	*External Character.*	*Chemical Qualities.*
3. Oxalate of lime. Mulberry calculus.	Colour, dark brown. Surface, uneven, tuberculated. Structure, imperfectly lamellated, hard, and compact. When removed not likely to reappear.	Before the blowpipe is decomposed, the oxalic acid passing off, and the lime remaining. Soluble in hydrochloric acid, from which the lime may be subsequently precipitated by ammonia.
4. Phosphate of lime.	Colour, pale brown. Surface, smooth and polished. Structure, irregularly laminated; laminæ rarely separate.	Before the blowpipe infusible; soluble in hydrochloric acid, from which it is thrown down by ammonia.
5. Ammonio-magnesian phosphate.	Colour, nearly white. Surface, uneven, often covered with small crystals. Texture, not lamellated. Fracture, irregular, earthy appearance, rarely crystalline. Shape, oval. Liable to reappear.	Before the blowpipe gives off ammonia, and fuses with difficulty; when potash is added to it ammonia is evolved. It is soluble in dilute acids.
6. Ammonio-magnesian phosphate, with phosphate of lime. (Fusible calculus of Woollaston.)	Colour, white, resembling chalk. Surface uneven. Texture friable.	Before the blowpipe it fuses readily; is very soluble in dilute hydrochloric acid.
7. Cystic oxide.	Colour, yellowish-white. Surface, smooth, but exhibits a crystalline appearance. Structure, crystalline, but not lamellated. Fracture, presents a glistening lustre.	Before the blowpipe is decomposed, and gives out a strong peculiar odour; is soluble in acids and alkalies, forming crystals with both.

Many calculi, and indeed most, are not of one uniform composition, but consist of strata of two or three varieties, one forming a nucleus for other deposits; uric acid is more common as a nucleus than any other substance. Calculi thus constituted receive the name of *alternating*. The change may depend upon alteration in the diet, habit, and mode of living, on the morbid state set up in the bladder, and much upon the medicines which have been used for their removal.

Urinary calculi are most frequent in children, less so in old persons, and least common in adult and middle age; more common in temperate than mild climates; in children they are most frequent amongst the poor and ill fed, but in old persons more common in the rich, luxurious, and indolent. Females are less liable to calculus than males, which may be partly explained by a small concretion more easily making its way through their short and dilatable meatus urinarius. Urinary calculus is more frequent in some districts than others; and locality likewise influences the species of the stone. Norwich is particularly remarkable for the number of stone cases, whereas there are other large towns where such have scarcely been heard of. Soldiers and sailors are comparatively free from this disease, which fact is attributed to their active employment, regular diet, and free cutaneous exhalation In some families, the formation of stone appears to be hereditary, and especially in those who are also subject to attacks of gout.

A calculus in the bladder has then either descended into it from one of the kidneys, or has formed in it around some foreign body, that has served as a nucleus for the deposit of the calculous matter. A stone in the bladder is usually attended with the following symptoms: a frequent desire to pass water; acute pain in the glans penis and course of the urethra; a sudden stoppage of the flow of urine from the falling of the stone against the neck of the bladder, if the patient be in the erect posture; and great suffering at the same time from the bladder contracting around the stone, producing what is called a fit of the stone; the urine is frequently mixed with clots of blood especially after exercise, and if the disease have been of long continuance, it will be of a whitish colour, and mixed with flakes of matter. There is some irritability of the rectum, and general constitutional disturbance. In children the prepuce becomes elongated from their constantly pulling at it, and not unfrequently a prolapsus ani exists. After some time patients learn to avoid making urine in the erect posture, and adopt the horizontal, lying either on the back, or on one side.

As most if not all these symptoms may be present without a stone being in the bladder, as, for example, in enlargement of the prostate gland, particularly of the middle lobe, fungous tumours of the bladder, or even an inflammation of its mucous membrane, no surgeon is confident of the presence of a calculus until he has, by sounding, ascertained its presence distinctly. This is effected by passing the sound into the bladder and striking the stone. Should the calculus not be discovered at first, the instrument should be moved from side to side, and the position of the patient changed; thus, if he have been first sounded in the erect position without success, he should be placed in the recumbent, and vice versâ. As the stone sometimes lodges in the "bas fond" of the bladder, and thus may be passed over by the instrument, the finger should be introduced into the rectum, and the calculus, if present, pushed upwards, so as to come in contact with the sound. A calculus has sometimes been detected when the sound has failed, by passing a silver catheter into the bladder. The sudden escape of the urine along the catheter forces the stone against the extremity of the instrument, and thus the stone is discovered. The surgeon should always feel the stone distinctly before he pronounces on its being present, as the striking of the instrument against foreign bodies in the rectum, against the sacrum, an enlarged prostate gland, or a thickened fold of mucous membrane, is liable to mislead him. When this stone is of small size, it may possibly be removed through the urethra, by dilating this canal, as recommended to be practised by Sir A. Cooper. It has been suggested that the injection of fluids into the bladder, which are known to act as solvents of the stone, when removed from the viscus, should be practised; this plan, although frequently tried, has been found of no avail, as the solvents, if injected into the bladder of sufficient strength to have an effect on the stone, will also act on the bladder. The only injections of use are those of an anodyne quality, which lessen the irritability of the bladder, and thus relieve the patient. When the presence of a large stone has been determined on, it may be removed by the operation of lithotomy, provided there is not any local or constitutional disease to forbid its performance, and the stone is not encysted, or adherent. The operation is performed as follows:

The rectum having been emptied by an enema a few hours before the operation, and the patient having been desired to retain his urine for an hour or two previous to its performance, he is placed near the edge of a table of convenient height, having his hands and feet tied together, and a pillow placed beneath the buttocks. *First introduce the sound, and ascertain that the stone is still free in the bladder;* pass in the grooved staff,* and confide it to the care of an assistant, who at the same time draws up the scrotum and penis, and makes the perineum tense. The knees of the patient being held steadily apart, make the first incision in perineo, commencing it immediately behind the posterior edge of the scrotum, and to the left of the raphe; carrying it downwards, backwards, and outwards until you terminate it midway between the anus and tuber ischii. This incision cuts through the integuments, the subcutaneous cellular tissue, and most probably a few fibres of the sphincter ani. Commence the second incision close to where the first began, and carry it backwards in the same line, and to the same extent; in this the perineal fascia is divided, and the knife, passing into the triangular interval between the muscles of the perineum, divides the perineal vessels and nerves, and cuts across the transversus perinei muscle, vessels, and nerves, and behind these, the middle fibres of the levator ani. Now take the staff in the left hand, and, inclining its handle towards the right side of the patient, press it towards the wound in the perineum. Now feel for the groove with the nail of the index-finger of the left hand; and, having satisfied yourself of its situation, introduce the point of the knife or gorget,† into it, through the membranous portion of the urethra immediately behind the bulb; raise the staff, and with it the knife, in the groove towards the arch of the pubis, so as to avoid the rectum as much as possible; move the point of the knife in the grove of the staff, that you may be assured of its not having slipped from it, depress the handle of the staff, still keeping it well raised, and at the same time push the knife upwards, and backwards, into the bladder, cutting through the membranous portion of the urethra, the anterior fibres of the levator ani, or Wilson's muscles, the triangular ligament, and the left lobe of the prostate gland, so as to leave one third above the incision, two thirds below it. The urine now escapes from the bladder: withdraw the knife, and, in doing so, dilate the external wound, if necessary. Pass the index-finger into the bladder, and feel for the stone, and remove it with the finger if possible. If this cannot be effected, withdraw the staff, and pass the gorget into the bladder along the finger, withdraw the finger, and along the gorget pass the lithotomy forceps into the bladder, seize the stone in its largest axis, and remove it carefully through the widest part of the wound. Pass the finger again into the bladder, and ascertain if there should be another stone; if so, remove it, and so on until the bladder is completely empty. When the stones are very numerous, they may be removed with the scoop; and, if broken down, tepid water should be injected, so as to remove every portion of calculous matter, and prevent a nucleus remaining for the future formation of a stone. Sir A. Cooper prefers the allowing of the calculous matter to escape in the after treatment of the case, to the injecting of water into the bladder. When a stone is too large to be extracted with the forceps, it is better to break it up than contuse the parts by a forcible removal of it.

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* Some recommend that the sound should be introduced before tying up the patient. Others state that the staff will be sufficient to ascertain the presence of the stone without the sound.

† Sir A. Cooper prefers the gorget in operating on adult and old persons, and particularly if the prostate gland be enlarged.

The *after treatment* is extremely simple. The wound is left open, or only covered with some simple ointment, and in a dependent position, that the urine may flow freely through it; an anodyne is given immediately after the operation, diluent drinks administered, and any symptoms of inflammation combated by the antiphlogistic regimen. In the course of two or three days, the urine begins to flow by the urethra, and is soon altogether discharged by this canal; the external wound heals from the bottom by granulations.

The following accidents may occur during the performance of the operation of lithotomy:

Wound of the *internal pudic artery*. This vessel is in danger of being wounded, if the knife should be too much lateralised, or turned outwards in making the last incision. If wounded, the artery should be at once compressed against the inner surface of the tuber ischii with the fingers, and subsequently secured with a ligature. In some cases the dorsal artery of the penis arises as a distinct branch from the internal iliac artery, and runs along the lateral surface of the neck of the bladder to its destination. Under these circumstances, it is almost impossible to avoid it in the last stage of the operation ; and, as the source of the hemorrhage cannot be ascertained, it will prove fatal, if not restrained. The introduction into the wound of a piece of sponge, perforated by a female catheter, so as to admit of the escape of the urine, is the best means of arresting the bleeding, as also any serious hemorrhage that may arise from other obscure sources.

Wound of the rectum. This intestine will be wounded, if the edge of the knife be directed too much inwards in making the incisions. Although an inconvenient, it is not a serious accident, as the wound may heal without any unpleasant consequences ; if not disposed to heal, the intestine may be cut through, as in the operation for fistula in ano.

Slipping of the knife or gorget from the groove in the staff. This is one of the most serious accidents that can occur in the operation, as the instrument is thus pushed between the bladder and rectum ; and the operator, imagining he has cut into the bladder, proceeds to extract the stone. Introducing the forceps for this purpose, he seizes the stone covered by the coats of the bladder, and in vain endeavours to remove the calculus. The injury thus done is most frequently fatal.

Wounds of the cul-de-sac of the peritoneum, the vasa deferentia, vesiculæ seminales, or ureter. These accidents occur from prolonging the incision too far backwards. Wound of the peritoneum is usually fatal, from inducing peritonitis. Division of the ureter is always fatal from the extravasation of the urine that takes place into the cellular tissue of the pelvis.

The operation of lithotomy proves *fatal* from

Peritonitis. As this frequently succeeds the operation, it should be carefully watched ; and any symptoms, such as pain on pressure above the pubis, should at once be treated by the application of leeches, and, if necessary, by general bloodletting, and the use of calomel and opium.

Inflammation of the wound, neck of the bladder, and bladder. This occurs when much force or violence has been used in the removal of the stone. Disease of the bladder may supervene, even when the operation has been most skilfully performed, in cases where the viscus has been diseased before the operation.

Extravasation of urine in the cellular tissue of the pelvis, causing extensive sloughing of this structure. This accident occurs, either from the wound in perineo not being sufficiently large; from the urine not being allowed a free exit after the operation, in consequence of placing the patient in an improper position, or applying dressings unnecessarily to the wound, or from a wound of the ureter.

Diffuse cellular inflammation. This is an erysipelatous inflammation of the cellular tissue of the pelvis, terminating in partial sloughing, and the formation of matter in the cells of the cellular tissue. It is attended with a low irritative fever; is exceedingly obscure in its symptoms, and insidious in its progress.

The high operation, or that above the pubes, and the recto-vesical operation of lithotomy are now, it may be said, wholly abandoned. They may be performed as directed for tapping the bladder above the pubes or through the rectum; and are still more exposed to the objections already stated, as applicable to these operations.

When calculi form in the female bladder, they may be removed by dilating the urethra, or dividing the canal towards its upper and outer part. The operation of lithotrity, however, bids fairly to supersede all other operations for stone in the female subject.

Dupuytren's operation of lithotomy. The operator renders the skin of the perineum a little tense, by pressing it down with the fingers of his left hand placed at the anus, and then, with a scalpel, a curved incision is made through the integument, commencing at the right side, between the ischium and the anus, and terminating at the corresponding point at the opposite side. The concavity of the curve thus described looks downwards to the anus, and its convexity upwards to the bulb of the urethra; its centre being about five or six lines above the former point. A second incision is made in the same direction, and to the same extent, through the muscles and deep fascia. In the next place, the operator with the index-finger of the left hand, feels for the curve of the staff in the urethra at the top of the wound, and there he introduces the point of his scalpel. When secure of its position, he runs it in the groove from before backwards, for four or five lines, so as to divide the membranous portion of the urethra. This being effected, the point of the double lithotome is placed in the groove of the staff, its concavity being turned up towards the pubic arch; then the operator, taking hold of the handle of the staff, draws it down towards him, and passes the lithotome back into the bladder. The staff is withdrawn, and the lithotome turned, so that its concavity shall look downwards. Its blades are separated to the required extent, and the instrument drawn steadily outwards, its handle being at the same time a little depressed, so that it is made to cut downwards and outwards. In this way the prostate gland, and the neck of the bladder are divided at each side, and a lunated flap, composed of the lower segment of these structures, is formed. This operation is named the bilateral, and is said to have the advantage of not exposing the rectum or pudic arteries to danger.

Operation of lithotrity. This operation consists in passing an instrument named the lithotrite, into the bladder, by which the stone is broken up, so that the pieces may be afterwards expelled by the urethra. It is performed as follows:

Inject a quantity of tepid water into the bladder by means of a catheter, so as to moderately distend this viscus; introduce the lithotrite, and, grasping the stone within the blades of the instrument, crush the calculus; repeat the process, until no portion of a large size remains. This operation, although likely to be exceedingly useful in the adult subject, is not fitted for the young. In cases, too, where there is an inflamed state of the bladder or urethra, or a diseased condition of the prostate gland, the operation of lithotomy appears to be preferable. After the operation of lithotrity, all inflammatory symptoms should be carefully watched, and the necessary treatment adopted to arrest its progress.

BURNS AND SCALDS.

Scalds are produced by hot fluids, and seldom penetrate deeper than the cutis, causing a separation of the cuticle. *Burns*, on the contrary, may extend to the deepest-seated structures. Burns on the head or trunk are more dangerous than those on the extremities; a burn which affects a more extensive surface is to be dreaded more than that which penetrates deeper without affecting any great extent of surface. They are more fatal in the young and old subject than in the vigorous adult.

Burns are divided into, 1st, those which affect the cutis to such an extent as to produce a vesication by the effusion of serum beneath the cuticle; 2d, those in which the cutis is more injured, and which generally terminate in suppuration; 3d, those in which the cutis is destroyed, and ultimately sloughs; 4th, those which extend to the deeper-seated parts, producing mortification beneath the skin.

Where vesications form on the surface from a burn, cold evaporating lotions should be applied, such as the camphorated spirits of wine, the lotio acetatis plumbi, or cold water, in order to prevent the vesicles from bursting, and to lessen the inflammation. If the vesicles be opened at first much pain and constitutional disturbance will be the result from the exposure of the inflamed cutis to the atmospheric air. At a later period, when the inflammation of the cutis has been subdued, the vesicles may be opened, when the old cuticle peels off, and a new cuticle is formed. Some practise the puncturing of the vesicles with a fine needle, at the early stages. The operation frequently gives relief, if the access of air can be prevented.

In the second form of burn, the cuticle is at once destroyed, and the inflamed cutis exposed; the consequence is that the cutis soons form a suppurating surface, as after the application of a blister. The spirit of turpentine is the best application in the first instance to this form of burn, as the object is to excite a speedy reaction; linimentum calcis or a mixture of lime-water and milk will also be found useful. Some recommend the wrapping of the parts in cotton; the advantages of this remedy are of a very negative description. When the cutis suppurates, the sore may be dressed, as after a common blister. This form of burn frequently proves fatal, if the surface injured be extensive, as when a person falls into boiling water or wort.

The third and fourth forms of burn may be considered together. These accidents are more frequently caused by the clothes taking fire, the explosion of gunpowder, the boiling over of hot fluids or metals in laboratories, manufactories, &c. When extensive, the patient, if seen immediately after the accident, is found suffering from collapse, caused by the shock of the accident; he is insensible, the skin is cold and pale, except where burned, here it presents an ash-coloured appearance, varying from a deep black to a yellowish tinge, according to the violence done to the part; the pulse is quick, weak, and scarcely to be felt; the patient suffers no pain. Brandy and ammonia should be freely administered, and the warm linimentum calcis or spirits of turpentine applied to the burnt parts. The collapse may last for some hours, or even prove fatal. If not fatal, it is succeeded by the stage of reaction. In this the pulse rises, the skin becomes warm, and the patient sensible, pain makes its appearance, and perhaps vomiting sets in. The same remedies may be applied, but with more caution, until reaction has been established, when stimulants should be laid aside, and the third stage, or that of inflammation guarded against. The inflammatory stage is characterized by the usual local and constitutional symptoms attendant on inflammation. The antiphlogistic regimen may be observed in this stage, but with much caution, as the patient's strength requires to be husbanded to meet the future stages of sloughing and cicatrization. Poultices may be applied to the deeply-burnt parts in order to expedite suppuration, and the separation of the sloughs, which constitute the fourth stage of burn. The process which takes place in this stage, is that observed in the separation of sloughs from other causes. The same treatment is also applicable here. The patient's strength should be supported by a liberal use of nutritive food, wine, bark (if it should be found to agree with the patient), and opium. The latter remedy is of much service, as there is always a great tendency to relaxation of the bowels, which is best controlled by this medicine, or a combination of it with chalk mixture. When the sloughs have separated, and suppuration is established, the fifth stage or that of cicatrization commences. The poultices may now be laid aside, and moderately stimulating ointments, such as the ceratum calaminæ, unguentum zinci, unguentum nitratis hydrargyri dilutum be applied. Lotions too will be found useful, particularly as they are more efficacious than ointments in lessening the discharge, which is usually profuse:

of these the best are the lotio acetatis zinci, liquor plumbi, diacetatis dilutus, lotio sulphatis aluminis, lotio sulphatis zinci, and lotio sulphatis cupri. The treatment of the suppurating surface is often troublesome, from the exuberance of spongy granulations, and frequent bleedings from the surface. The sulphas cupri, or nitras argenti used in substance, or pressure, if it can be properly applied, or the pulvis calaminæ will be found most efficacious under these circumstances. As the wound cicatrizes there is a great tendency to contraction, so much so, that naturally distinct parts may be united together, the motions of the joints destroyed, or great deformity produced. The occurrence of such accidents should be prevented by proper position, splints and bandages, which should be worn for some time after the cicatrization has taken place.

Burns may prove fatal in any one stage; thus in the *first* stage, or that of collapse: from the shocks of the accident causing a too great sinking of the powers of life.

In the *second*, or that of reaction: from the reaction being too slight, and the patient again sinking into a state of collapse.

In the *third*, or that of imflammation: from the violence of the imflammatory fever, or from inflammation attacking some of the internal organs, such as those of the head, thorax, or abdomen.

In the *fourth*, or that of sloughing, and suppuration: from the constitutional irritation induced, from hectic fever, and the gradual sinking of the patient.

In the *fifth* or that of cicatrization: from debility, or effusion into one of the cavities, most frequently the head, or from organic disease of the thoracic or abdominal viscera.

A patient, who has suffered from an extensive burn, especially if young or advanced in life can seldom be pronounced out of danger until cicatrization has been completed. Tetanus sometimes appears during the treatment of a burn, and most frequently about the period of the separation of the sloughs.

ON TETANUS.

Tetanus is a spasmodic contraction of the muscles, principally of voluntary motion, attended with permanent tension, and rigidity of the parts affected, in which it differs from ordinary spasmodic affections. When the tetanic affection is confined to the muscles of the lower jaw, the disease is named *trismus* or *locked jaw*, but when more extensive is termed tetanus. When the body is bent forwards, it is called *emprosthotonos*, backwards, *opisthonos*, and to one side, *pleurosthonos*.

Tetanus is divided into the *acute* and *chronic*. The first is the most dangerous form, and most frequently met with in this country; the last is not so fatal. Tetanus is also divided into the *traumatic* or that arising from a wound, and *idiopathic* or that induced without any obvious cause. Traumatic tetanus is that most usually met with in temperate climates. Any form of wound may produce it, but it more frequently follows lacerated wounds, and particularly those implicating fasciæ or tendinous structures, as in the palm of the hand or sole of the foot. The particular state of the wound seems to have no effect on the supervention of the disease, as it has appeared in all conditions, even when the wound has presented a most healthy appearance. Many conceive that laceration of some of the nerves of the part has an influence in producing tetanus, but the point is not decidedly established. The period too of the supervention of the disease after the receipt of the injury is exceedingly variable; in one case it made its appearance immediately, and proved fatal in fifteen minutes after, in many others it does not appear for weeks. The attack in general comes on gradually. The commencement is announced by a sensation of stiffness about the neck, root of the tongue, and muscles of the lower jaw, and some difficulty of deglutition. Soon after, the disease becomes fully marked, and spasms set in. The patient now lies in a supine posture, with his limbs violently extended, the muscles of his face are contracted, his eyebrows corrugated, the upper eyelids drooping, the alæ nasi extended, the angles of the mouth drawn backwards, and slightly downwards, and the teeth closed, or nearly so. The abdominal muscles are particularly rigid, and become as "hard as a deal board." The legs are stretched, the feet and toes extended; there is an acute pain, which passes backwards, from the lower extremity of the sternum to the spine, apparently through the diaphragm. The spasms are particularly violent, and throw the body and head either forwards, backwards, or to one side, according to the form of the disease; they last but for a short time, seldom more than a few seconds, and return at intervals of variable duration. In severe cases the spasms appear as often as every minute, but in others, there are but a few in the course of the twenty-four hours. The functions of circulation and respiration are but little affected; the patient breathes with tolerable freedom, except during the spasms; and the pulse is but little affected, except immediately after the attacks, or in the advanced stage of the disease, or shortly before death. There is a partial moisture on the skin chiefly about the face, neck, and chest. The bowels are obstinately constipated, and the urine is scanty and high coloured. There is also a peculiar odour about the patient, which will alone serve to distinguish the disease. The sensorium is not affected. The acute form of tetanus generally proves fatal on the third or fourth day from the violence of the disease, and the consequent exhaustion of the patient. In some there is a remarkable relaxation of the spasms shortly before death, so as to give rise to the hope of a recovery, when a few spasms of extreme violence, and following each other with unusual rapidity, terminate the patient's sufferings. The chronic form of the disease is usually prolonged for some weeks, and is frequently followed by recovery, the disease gradually disappearing. When fatal, it is so in general from the supervention of some organic affection especially of the lungs. The muscles of the upper extremity are seldom affected, except in the chronic form. The remedies recommended for tetanus are numerous; they are bleeding, in its various modes, purgatives, opiates, antispasmodics, the warm and cold bath, stimulants, mercury, amputation, division of the wounded nerves, tobacco in the form of fomentations, and enemata, &c. All these have been tried, and most frequently without effect. Tobacco seems to have a powerful influence in allaying the severity of the spasms. In the chronic form most of these remedies will be found useful, if a judicious selection be made, and that remedy resorted to which is most applicable to the symptoms, the age, and constitution of the patient. The introduction of a piece of wood between the teeth is always judicious, as it prevents injury of the tongue, so likely to occur during the spasms.

Trismus nascentium is a tetanic affection, which attacks children shortly after birth, chiefly in hot countries. The disease is ascribed by many to an irritable state of the divided umbilical chord. It is generally fatal.

ON THE MALIGNANT DISEASES.

Cancer is a disease of advanced life, although occasionally met with in young subjects. It is divided into *scirrhus* or *occult cancer*, and *ulcerated* or *open cancer*. These are but different stages of the same disease. Cancer usually attacks three structures in the human body, namely, secreting glands, skin, and mucous membrane. It is not confined to these, but may commence in almost any other structure, or extend to it by absorption or by gradual increase. Of the secreting glands, those most usually affected are the mamma in the female and the testis in the male. The lymphatic or absorbent glands are never affected primarily with cancer. A case of scirrhus mammæ may be selected to point out the course of this formidable disease. Cancer usually makes its appearance in the female breast from the age of forty to fifty, when the catamenia are about to cease, and more frequently in single than in married women. Some ascribe its origin to a blow on the part, or the pressure of some portion of the dress, as the upper part of the stays; whilst others can assign no cause for its commencement. It first appears as a small, hard, indolent, and moveable tumour in some part of the breast, knotty and irregular to the touch. From this it gradually increases in size, and becomes painful, sharp lancinating pains darting through it in different directions. As the diseased mass enlarges, it contracts adhesion to the surrounding parts, to the muscle behind, the skin in front, and thus becomes partially fixed. There is now an increase in the pain, together with a remarkable retraction of the nipple, and the veins on the surface become much enlarged and varicose. Soon after the gland becomes adherent to the skin, this inflames, gradually thins, and at last gives way, when the scirrhus becomes an open cancer, presenting an irregularly ulcerated surface, which rapidly increases, until it occupies a large portion of the tumour. The cancerous ulcer thus formed is circular in shape, its surface is irregular, and covered with hard fungous granulations, giving it a cauliflower appearance; these granulations bleed on the slightest injury. The centre of the ulcer is depressed, or hollowed out into a cavity, which is partially filled with a fetid ichorous matter, while the edges are everted. The discharge is profuse, and consists of two kinds, a thin and extremely fetid, ichorous matter, which flows freely, and a more tenacious lymph-like fluid, which adheres to the surface. The lancinating pains are now extremely severe, but are occasionally relieved by a discharge of blood from the surface. There is also a burning heat complained of over the ulcerated surface. On examination, the neighbouring lymphatic glands in the neck, axilla, &c. will be found much enlarged, and frequently painful, the pain being either that of common inflammation, or the lancinating pain of scirrhus. The constitution too sympathises much, however free it may have been (as sometimes is the case) before the ulcer was formed. As there is a species of irregular hectic fever setting in with a peculiar leaden hue of the integuments, the disease progresses, the ulceration extends, until at length the patient sinks beneath her sufferings, and the repeated discharges of blood, or dies from the disease having extended itself to the thoracic viscera. There is but one plan of treatment for cancer that holds out any prospect of success, which is extirpation; and this performed, too, at an early period of the disease, before the constitution becomes infected, or any of the important structures in the neighbourhood of the disease are implicated. Various remedies have been resorted to from time to time to alleviate the patient's sufferings, or correct the discharge; of these opiates will be found the most useful. The carrot, charcoal, or hemlock poultice applied to the ulcer will be found often beneficial. In some cases cancer increases slowly, so that if the patient be already advanced in life, she may live for many years without much suffering, and ultimately die of some other affection. In such, an operation may be dispensed with. When a cancer returns after the operation has been performed, it usually appears in the site of the wound formed by the operation, or in the surrounding lymphatic glands.

Cancer commences on a mucous membrane, as, for example, on the free border of the lip in the male subject in the form of a tumour, a crack, fissure, or an ulcerated surface. Sometimes a horny excrescence ushers in the disease. The pyloric extremity of the stomach and lower part of the rectum are peculiarly liable to cancer. The existence of numerous glands in those situations no doubt predisposes to the disease. Cancer may appear in the skin, as in mucous membrane; in general it attacks one of those warty excrescences, so often met with in the integuments, and especially in those of the face.

Fungus hæmatodes has been also called *spongoid inflammation*, *medullary sarcoma*, *soft cancer*, &c. This disease usually appears at the earlier periods of life, but there is no age nor structure wholly exempt from its attacks. It has been met with in the eye, the thoracic and abdominal viscera, the testes, extremities, indeed in almost every part of the body. In the extremities the disease begins with a small colourless tumour, which is soft and elastic, if there be no dense covering over it, such as a fascia; but if so covered, it presents a tense swelling. At first it is free from uneasiness, but by degrees a severe acute pain shoots occasionally through it, then more and more frequently, and at length becomes incessant. For a considerable time the tumour is smooth and even, but afterwards it projects irregularly at one or more points, and the skin at those places becomes of a livid red colour, and feels thinner. In this situation it easily yields to pressure, but instantly bounds up again. Small openings now form in these projections, through which is discharged a thin bloody matter. Almost immediately after these tumours burst, a small fungus protrudes like a papilla, and this rapidly increases both in breadth and height, and has much the appearance of carcinomatous fungus, the granulations being however softer and more exuberant, and frequently bleed profusely. The matter is thin, and exceedingly fetid, and the pain becomes of the smarting kind. The integuments for a little way around these ulcers are red and tender. After ulceration takes place, the neighbouring glands swell, and assume exactly the spongy qualities of the primary tumour. If the patient still survive the disease in its present advanced progress, similar tumours form in other parts of the body, and the patient dies hectic. Fungus hæmatodes appears sometimes to be caused by external violence, but often arises idiopathically. The only treatment for the disease is its mechanical removal. It is a more constitutional disease than cancer, and but few cases occur in which the disease does not reappear after an operation.

A cancerous tumour, when cut into, presents a striated appearance, having a central hard mass, from which bands pass off in every direction as radii from a centre. It seldom is encysted.

The fungus hæmatodes tumour is composed of an irregular mass of brain-like matter mixed with clots of blood, and not unfrequently portions of bone. They are usually but not always inclosed in a cyst.

When fungus hæmatodes attacks the eye, the first signs are observable in the posterior chamber; an appearance like that of polished iron presenting itself at the bottom of the eye. The pupil becomes dilated, and immoveable, and, instead of having its natural deep black colour, it is of a dark amber, sometimes of a greenish hue. The change of colour becomes gradually more and more remarkable, and at length is discovered to be occasioned by a solid substance, which proceeds from the bottom of the eye towards the cornea. The surface of this substance is generally rugged and unequal, and ramifications of the central artery of the retina may sometimes be seen running across it. The anterior surface of the new mass at length advances as far forwards as the iris; and the amber or brown appearance of the pupil has in this stage been known to mislead surgeons into the supposition of there being a cataract, and induce them to attempt couching. The disease continuing to increase, the eyeball loses its natural figure, and assumes an irregular knobby appearance. The sclerotic also loses its white colour, and becomes of a dark blue or livid hue. The cornea soon sloughs, and the diseased fungus protrudes. According to Mr. Travers, the lens and cornea are the only textures of the eye in which fungus hæmatodes may not originate. An eye affected with fungus hæmatodes should be removed as soon as possible, in order to prevent the optic nerve and brain taking on the same diseased action.

Melanosis is also a malignant affection, and consists of a deposit of a black carbonaceous substance in the tissue of organs. It usually attacks internal organs, seldom appearing externally. It is wholly beyond the control of art. It sometimes appears as a subcutaneous affection in the form of small encysted tumours, containing a dark reddish fluid.

Spina bifida. This is a malformation or arrest of development in the posterior part of the spinal column, in which, from the process of ossification not being completed, the spinous processes are wanting and thus the spinal canal is not closed. A tumour soon forms and protrudes through the aperture. This tumour is formed by the membranes of the spinal marrow which are forced outwards, by a collection of serum in the interior of the canal.

Treatment. The tumour should be punctured with a fine needle, and the serum given exit to; pressure should now be applied over the part so as to prevent if possible the reappearance of the tumour and allow of the completion of the spinal column: should the tumour return, it should be again punctured. This practice is to be repeated as often as may be necessary. The case seldom terminates favorably, when a large portion of the spinal canal is imperfect. This affection, although not confined to any particular part of the spinal columns, is most frequently met with in the lumbar region. A similar arrest of development is occasionally met with in the posterior part of the head, when the membranes and substance of the brain become protruded so as to form a tumour. Pressure alone, and that gently and moderately applied, can be resorted to in this case with safety.

Paronychia or *Whitlow* is an inflammation of one of the fingers or toes, of a very painful nature, and much disposed to suppurate. Paronychia is divided into four kinds, according to the depth of the imflammation: 1st, the most superficial which is situated immediately under the cuticle; 2d, when the inflammation is situated beneath the cutis; 3d, when the inflammation is situated in the sheaths of the tendons; 4th, where the inflammation lies beneath the periosteum. The first and second forms of paronychia attack the ungual phalanx. There is, in general, a good deal of pain in the part, and some redness and swelling, particularly about the root of the nail. The application of leeches and warm fomentations to the part will in general give relief, and sometimes cause the resolution of the inflammation. In general, some matter forms, and most frequently near the root of the nail, which requires to be discharged with the point of the lancet, when the disease usually subsides. When the matter forms beneath the nail, this may be cut through to allow of its escape. This is best accomplished by first paring the nail, as thin as possible, with a piece of glass, and then using the point of the lancet. In these cases the nail is generally thrown off.

In the third form of the disease, when the inflammation is situated in the sheaths of the tendons, the symptoms are much more urgent. The whole finger is then engaged, there is most excruciating pain of a throbbing character, much aggravated by placing the finger in the depending position, and extending upwards to the hand, wrist, elbow, and even shoulders. There is but little redness or swelling. In most cases there is a considerable degree of fever, and the patient is deprived of rest. Leeches, warm fomentations, and poultices may be used in the early stages, but should the inflammation not abate by these means, an incision should be made on the anterior surface of the fingers down to the inflamed parts. This gives immediate relief, a small quantity of pus is discharged, and the disease subsides in a few days by the use of warm fomentations and poultices. If the disease be not arrested, the inflammation will spread upwards into the palm of the hand, from thence, beneath the annular ligament of the wrist, into the forearm, in all of which places abscesses will form, frequently attended with sloughing of the fasciæ and some of the tendons, particularly that of the finger first affected. Under these circumstances, deep and free incisions should be made into the inflamed parts, to give exit to the matter and sloughs, and poultices be afterwards applied. The use of the forearm and hand is often lost from the matting of the tendons and synovial sheaths caused by the inflammation; not unfrequently amputation is required.

Ganglion is an encysted, circumscribed, moveable swelling, commonly free from pain, causing no alteration in the colour of the skin and formed upon tendons in different parts of the body, but most frequently on the dorsum of the hand or foot. When ganglions attain a large size, they interfere with the action of the tendon with which they are connected, and may destroy the motion of the finger or of the hand. They are very troublesome on the dorsum of the foot, from their becoming irritated by the pressure of the boot or shoe. Ganglions are sometimes dispersed by the use of pressure and stimulating liniments. In general, this plan is ineffectual. The best method then is to rupture them with a blow given by a book or mallet. The contents of the sac are absorbed, and the cyst becomes obliterated, by the adhesive inflammation. When this plan is not likely to succeed, either from the size of the tumour, the thickness of the cyst, or from being situated amongst soft parts, as the bellies of the muscles, they should be carefully dissected out. Opening them is objectionable, as violent inflammation often results; not unfrequently a fungus of a most troublesome, and according to some of a malignant character, makes its appearance from the interior of the cyst. The contents of a ganglion consists of a viscid transparent fluid, resembling white of egg. In some cases these tumours contain a number of small white seed-like bodies.

Artificial anus is an artificial opening in some part of the abdominal parietes, by which the contents of the intestine escape externally. It is generally the result of strangulated hernia, but may be caused by wounds or other injuries of the abdomen. The disease is productive of much distress to the patient, as the intestinal contents are discharged involuntarily; the mucous membrane protrudes through the opening, and discharges a quantity of mucus, which excoriates the parts much, and the aperture becoming contracted, may prevent the passage of the contents of the intestine, and thus induce symptoms of strangulated hernia. We should treat this disease by endeavouring to cause the intestinal contents to pass along the natural canal; this is done by the administration of enemata, and by making pressure on the opening, by means of a truss; when the intestine, in which the artificial anus exists, may become sufficiently retracted, to allow of the descent of its contents into the lower part of the canal. In some cases this cannot be accomplished from the acuteness of the angle formed by the fold of intestine injured; the upper and lower portion of which, may be adherent together for some distance. For these cases, Dupuytren has recommended a species of forceps; the blades of which, being closed at the projecting angle, cause it to slough, and thus remove the obstacle to the cure of the disease; this practice, in most cases, has been found to induce such violent symptoms, as to deter surgeons from resorting to it. When the contents of the intestine cannot escape, and symptoms of strangulated hernia set in, the artificial opening may be dilated, or a gum-elastic tube passed into the intestine, and enemata administered, so as to remove the substance impacted in the aperture. In incurable cases, it will be necessary for the patient to wear a tin case or other receptacle for the contents of the intestine.

NOTES

ON

PHYSIOLOGY AND ANIMAL CHEMISTRY.

PHYSIOLOGY.

Disgestion is divided into the several processes of mastication, insalivation, deglutition, chymification, chylification, separation, and defecation.

Mastication, is the reduction of the food in the mouth into a soft pulpy mass; it is accomplished by the muscles of mastication, viz., the masseter, temporal, pterygoideus internus and externus, triturating the food between the teeth of the upper and lower jaw, between which, it is placed by the action of the tongue, and by the buccinator muscle, which compresses it from without, and thus prevents it from passing between the gums and the inner surface of the cheeks. While mastication is going forwards, the salivary glands are pouring their secretion into the mouth, by which the food is impregnated with saliva, or becomes *insalivated;* at the same time, the mucous glands secrete a quantity of mucus, which, mingling with the mass, reduces it to the proper consistence for the next step, or that of *deglutition.* The quantity of fluid added by the salivary and mucous glands to the food during a meal is supposed to amount to half a pint.

Deglutition is the passing of the food or, as it is now called, the *alimentary bolus* from the mouth into the stomach. For the effecting of this object, the tongue collects the morsels of food into one mass, which is first placed upon its dorsum by the contraction of its muscular fibres, the lower jaw being approximated to the upper, and thus fixed; the top of the tongue is raised and pressed against the palate, immediately behind the incisor teeth by the action of the posterior fibres of the genio-hyo-glossi; the tongue now shortens itself, and is rendered convex, from before backwards, by the action of the linguales and genio-hyo-glossi, and thus compresses the bolus against the palate or roof of the mouth, so as to force the bolus backwards into the the upper part of the pharynx; whilst these actions are taking place, the soft palate, larynx, and pharynx, are preparing for the reception of the bolus. The soft palate is raised by the levator palati muscle, so that its posterior margin touches the back of the pharynx, and its anterior surface forms an oblique plane looking downwards and forwards, which guides the food in its descent to the pharynx, and prevents it passing upwards towards the posterior nares. The larynx is drawn upwards and forwards under the root or base of the tongue, by the digastric, genio-hyoid, genio-hyo-glossi, and palato pharyngei muscles, by which its upper opening is protected; and still further so, by the epiglottis which descends upon it. This elevation of the larynx causes a dilatation of the pharynx from before backwards, this cavity being distended at the same time in the transverse direction by the stylo-pharyngei muscles; the pharynx is thus opened for the reception of the alimentary bolus, which drops into it, and is immediately propelled onwards by the constrictor muscles into the œsophagus, along which it passes more slowly into the stomach.

Chymification, which is the conversion of the food into chyme, takes place in the stomach, and is accomplished by the active properties of the gastric fluid, which not only dissolves the food, but occasions certain changes in it, whereby its original characters are considerably, if not altogether lost. The old opinions of fermentation, concoction, putrefaction, and trituration, being the processes by which the food is changed into chyme are now abandoned; as it has been found, that *fermentation* does not take place, except in a morbid condition of the stomach. There is not sufficient heat in the stomach for the conducting of any process corresponding to *concoction.* The gastric juice, when removed from the body, is found to possess an antiseptic property, thereby preventing *putrefaction;* and Spallanzani has introduced portions of food into hollow ivory balls, perforated with numerous foramina, in which the food, notwithstanding that all pressure of the stomach was removed from it, became converted into chyme; thus disproving the theory of *trituration.* The nervous influence has much effect on the process of chymification; but this cannot be considered (as some modern physiologists would contend) as the sole agent in effecting the conversion of the food. Chymification is conducted chiefly in the splenic extremity of the stomach; and first on those portions of the food which are most exposed to the mucous surface; the chyme is then passed towards the pyloric end, whence it escapes through the pylorus into the duodenum. The time necessary for the perfection of the process of chymification of the food varies much according to the quality of the latter; the average period may be stated at from three and a half to four hours, as appears from experiments lately performed by Dr. Beaumont in America.

Chylification takes place in the duodenum; it is effected through the agency of the duodenal biliary and pancreatic fluids, which convert the chyme into chyle; that is, cause a separation of the nutritious from the useless portions: the first, forming the *recrementitious* part, passes along the small intestines, from which it is taken up by the absorbents of the mesentery, named lacteals, and carried into the thoracic duct, and by this into the general circulation; the second, the *excrementitious* or *fecal* part, passes along the small into the large intestines, where it receives the peculiar characters of fæces, probably from the secretions of the vermiform appendix, and from these is expelled by the act of defecation.

The principal fluids engaged in the process of digestion are as follows:

Saliva, according to the analysis of Tiedemann and

Gmelin, contains 1·16 per cent. of solid residue on evaporation : this is composed of salivary matter, osmazome, mucus, albumen, fatty matter united with phosphorus, potash combined with acetic, phosphoric, sulphuric, hydrochloric, and sulpho-cyanic acids; some phosphate and carbonate of lime, and a minute quantity of magnesia.

Gastric juice, according to Dr. Beaumont and Dr. Dunglison, is composed of free hydrochloric and acetic acids, phosphates and hydrochlorates of potash, soda, magnesia, and lime, and animal matter soluble in cold, but insoluble in hot water. The gastric juice owes its solvent properties, principally to the hydrochloric acid which it contains.

Pancreatic juice is supposed to resemble the salivary fluid in most respects; but has not been obtained from the human body sufficiently pure for accurate analysis. From examination of it in animals, it appears to differ from saliva, in containing albumen, casein, and free acetic acid, and in not containing salivary matter, mucus, and sulpho-cyanic acid.

Bile is composed of water, mucus, resin, picromel, cholesterine, cholic acid, colouring matter, casein, osmazome, several neutrals salts of soda and potash, with some free soda. The bile exerts an alkaline reaction.

The passage of the chyle and fæces is principally produced by the peristaltic action of the bowels, dependent on the circular and longitudinal fibres, aided by the pressure of the surrounding muscles. The fæces are voided by the contraction and pressure of the abdominal muscles and diaphragm, with a relaxation of the sphincter ani.

Dr. S. Smith, in his excellent work on the Philosophy of Health, traces the process of digestion to the formation of blood, in the following manner :

1st. In the chyme, there are traces of albumen, with globules not so numerous nor so large as the red particles of the blood, and without colour.

2d. In the chyle of the duodenum, the quantity of albumen is increased ; there are traces of fibrine and of oily matter, and the number of the globules is increased.

3d. In the chyle after passing the mesenteric glands, the albumen, fibrine, oil, and globules are further increased.

4th. In the chyle of the thoracic duct, these principles are so increased and resemble the state in which they are found in the blood, that the chyle removed from this duct, coagulates spontaneously, and separates into three parts: a clot resembling the crassamentum, a thin transparent fluid like serum, and a thin pellicle upon the surface of this, of an oily nature. This fluid also, exposed to the air, assumes a red colour, and abounds with globules, but smaller than the red particles of the blood.

5th. After the fluid of the thoracic duct has been mixed with the lymph from the spleen (according to Tiedemann and Gmelin), the quantity of fibrine is considerably increased; and it actually acquires red particles.

The lymphatics of the body generally carry a fluid of a more important quality than that usually assigned to it; for it contains fibrine, albumen, globules, and salts, in a combination much resembling that of the blood.

CIRCULATION OF THE BLOOD.

In describing the circulation of the blood, we shall commence with the right auricle: the venous blood received into this is propelled by the contraction of its walls into the right ventricle, from which its return is prevented by the tricuspid valve; the right ventricle then contracts, and forces the blood into the pulmonary artery, from which regurgitation is impeded by the three semilunar valves. By the pulmonary artery, the blood is conveyed to the minute vessels surrounding the air-cells of the lungs, and is brought back arterialized into the left auricle of the heart, thus completing the *pulmonic* or *lesser* circulation. The left auricle is then stimulated to contraction and propels its contained blood into the left ventricle, from which its return is prevented by the mitral valve. This ventricle, immediately contracting, forces the blood into the aorta; and from hence into the whole arterial system, the capillary branches of which, communicating with the capillary veins, the blood is here again changed into venous, and is returned by the various veins of the body into the superior and inferior venæ cavæ, which vessels convey it directly into the right auricle, thus completing the *systemic* or *greater* circulation. The heart is the most powerful mechanical agent in the circulation of the blood; the quantity of blood contained in it at one period, is estimated at about four ounces, two cavities only, viz. either the two auricles or ventricles, being filled synchronously, and each cavity being supposed to hold about two ounces. When the ventricles contract the heart is shortened, its apex is raised and tilted forwards, thus producing the impulse of the heart against the ribs. This contraction of the ventricles has been called the 'systole' of the heart, and the relaxation, the 'diastole.' For every contraction of the ventricles, a corresponding pulsation is felt in the larger arteries of the body; and for every pulsation of an artery, two sounds may be heard over the heart; they are a long deep sound, and a short and more harsh one: these sounds are explained variously by physiologists. Some contend that they are muscular, others that they are valvular; but, from the experiments performed during late years, they appear to be produced by both; the first long sound seems to arise from the contraction of the ventricle; the short sound, appears to be produced by the stretching of the valves by the retrograde impulse of the blood.

There is no provision against the return of blood from the right auricle to the venæ cavæ, excepting such as is produced by the column of blood in those vessels. In disease of the right side of the heart, some regurgitation of blood takes place into these vessels, producing a symptom known as the venous pulse. At the origin of the aorta, there are three semilunar valves corresponding with those of the pulmonary artery; these prevent the reflux of the blood from the aorta into the left ventricle; immediately beyond these valves are the orifices of the coronary arteries, into which the blood enters in a manner different from all other arteries of the body, that is, by regurgitation. This provision appears to be necessary on account of their proximity to the heart itself, for otherwise the impulse of the blood would have been too great for them to support.

The *arteries* are composed of three coats; an external or cellular, a middle fibrous or elastic, and an internal lining membrane. The cellular coat is dense, tough, and possessed of little elasticity: in addition to strengthening the vessel, it contains the vasa vasorum and nerves distributed to the arteries; the former are derived from the neighbouring vessels, the nerves from the ganglionic system. The middle coat, by some considered to be muscular, is composed of oblique and circular fibres; the oblique are the better marked and more external; these fibres retract and contract the vessels when cut across; they possess elasticity, and, according to some physiologists, also contractility. The elasticity of the arteries is of use to the heart by moderating the action of the left ventricle. The contractility of the arteries is of service in aiding the action of the left ventricle, by propelling the blood forwards, and causing it to circulate through the capillary vessels in a continuous stream. Many deny that the arteries are possessed of contractility; it is probable that the larger arteries are solely elastic, but that the smaller also enjoy contractility. Professor Müller denies the existence of muscular fibres in the middle coat of an artery, although the opposite opinion is entertained by some other eminent physiologists. The lining membrane of the arterial system is of a serous character; it is thin, smooth, and polished, thus affording a most suitable surface for the passage of the blood, and when injured, throws out lymph, by which the vessel may be closed or obliterated; this is connected with the middle coat by fine cellular tissue.

The *veins* have two coats, an external condensed cellular or fibrous coat, and an internal lining membrane. No muscular fibres are found in the venous system, excepting in the inferior vena cava, shortly before its entrance into the heart; they are therefore nearly passive in the circulation of the blood. The lining membrane is of a serous character, but less so than that of arteries, and is thrown into folds so as to form valves! these consist each of two folds, concave towards the heart: they are more numerous in the lower than in the upper parts of the body, and in the superficial than in the deep seated veins. The pulmonary veins and the system of the vena portæ are without valves. The active agents in circulating the blood in the veins, are the "vis a tergo" from the capillary arteries,—the contraction of the surrounding muscles, which force the blood onwards towards the heart, this fluid being prevented by the valves from passing in the contrary direction,—atmospheric pressure, especially on the more superficial veins,—and the vacuum, formed in the thorax during inspiration, by which and a vital elasticity, the right auricle is expanded and draws in the blood from the venæ cavæ. The capillary vessels are the minute ramifications of the arteries and veins, through which the globules of the blood are supposed to pass in single rows, and consequently not to be visible to ordinary observers. The arterial capillaries are supposed by some to possess a high degree of irritability and contractility, by which the blood may acquire a fresh impulse, and be more efficiently propelled along the veins; this would appear to be necessary, from the fact that, as the area of the branches of an artery is considerably greater than that of the primary trunk, and as many of these branches are given off almost at right angles, the force of the impulse of the heart must necessarily be weakened in them; to obviate this, then, it is supposed that, in proportion as the arteries subdivide, they acquire an increased degree of contractility.

The fœtal circulation. The ramifications of the umbilical vein in the placenta take up the blood conveyed there by the umbilical arteries, and conduct it into the umbilical vein, through the umbilicus to the abdomen of the fœtus. This vein runs along the longitudinal fissure of the liver, giving off branches both to its right and left lobes, and one which takes the course of the parent trunk, named the *ductus venosus;* thus a great portion of this blood circulates first through the liver, but the smaller quantity passes direct to the vena cava inferior. The blood of the inferior cava, on entering the right auricle, is guided by the eustachian valve towards the foramen ovale, which it passes through, and enters the left auricle; from this it is transmitted into the ventricle and thence into the aorta; nearly all this blood is distributed to the head and upper extremities, and is brought back by the superior vena cava, to the right auricle: from this it escapes into the right ventricle, and then into the pulmonary artery; in the fœtus, this vessel is divided into three branches, the two pulmonary arteries (then very small) and the ductus arteriosus which appears like the continuation of the vessel; a small quantity only of blood passes to the lungs, the bulk of it through the ductus arteriosus into the descending thoracic aorta, from which it circulates in the lower parts of the body, and passes in large quantity along the umbilical arteries to arrive again at the placenta.

THE BLOOD.

The blood, when first drawn from the body, has an uniform homogeneous appearance, a slight odour, and a peculiar saline taste, varying in colour from red to dark red, almost black, according as it issues from an artery or a vein. Its specific gravity is about 1·080; its temperature averages 98 degrees; if allowed to remain quiet, it coagulates in the space of from five to ten minutes; acquires a glutinous consistence, but on longer standing, changes its condition, and is separated into a thin, almost colourless, liquid, named the *serum*, and a more firm part, named *crassamentum*. The relative proportion of these varies in age, constitution, and disease; generally in the most vigorous health, and in an inflammatory state of system, the crassamentum is more abundant: but in early life and old age, and diseases of debility, the serum acquires an increased proportion. The crassamentum also, by standing, exhibits two portions, an upper one, semitransparent and yellowish, named *fibrine*, and the lower a stratum of dark matter, consisting of *red globules*.

During these changes, watery particles pass off with some animal matter, producing the peculiar odour of the blood, and caloric likewise escapes.

Serum, according to M. Lecanu, contains in 1000 parts,

Water	906·00
Albumen	78·00
Animal matter, soluble in water and alcohol	1·69
Albumen combined with soda	2·10
Crystallizable fatty matter	1·20
Oily matter	1·00
Chloride of sodium and potassium	6·00
Carbonate and phosphate of soda, and sulphate of potash	2·10
Phosphate of lime, iron and magnesia, with carbonate of magnesia and lime	·91
Loss	1·00

Fibrine in the blood of the living body is fluid and transparent; but when separated, assumes an opaque grayish appearance, and firm gelatinous consistence, formed of fibres which sometimes present an arrangement like network. It is insoluble in distilled water; treated with alcohol, is converted into a substance like adipocire; is soluble in caustic potash and ammonia, and treated with nitric acid evolves a large quantity of nitrogen. It is a large constituent also of muscular fibre: its proportion in the blood averages about four parts in 1000.

The red matter of the blood (red globules, or globules of the blood of many authors,) is its heaviest constituent, always tending towards the bottom of the vessel. The quantity present in blood averages about 100 parts in 1000.

The globules of the blood are difficult of examination, in consequence of their small size and softness; and hence, physiologists differ much concerning their shape, structure, and size. Some contend that the globules consist of a white solid nucleus within a red envelope; others, that the globules are like flattened circular cakes, with thickened margins, which thus produce an appearance of a central depression, and without a distinct envelope. Their diameter is estimated variously, from a two thousandth to the sixth thousandth of an inch. Professor Müller, is of opinion that the red particles are circular and flattened, with an appearance of being hollowed out in the centre, but not positively so; for he is convinced that a nucleus exists there, which is equal in diameter to the thickness of the blood-globule; and states that this nucleus has a yellower and brighter appearance than the transparent circumference.

The capsule is said to be soluble, the nucleus insoluble, in water. The colouring matter of the blood is called by many hæmatosin: its nature is disputed. Lecanu considers it to be a combination of globulin with albumen; Müller believes it to be fibrine with some iron: this iron is supposed generally to be oxydized, but some even imagine that it is in a metallic state.

The blood is considered by many to be possessed of vitality, which preserves to it, in the body, its fluid state. This vitality of the blood appears to vary in degree at various times; and according to this degree, so will be the rapidity of coagulation of the blood after its removal from the body. The less vitality there is, the more rapidly the blood coagulates; and this is evidenced in hemorrhages, in which it is found that the more the blood escapes from the body, so does the vitality of that remaining fluid diminish, and produces an increased tendency to coagulation, a beautiful provision for saving life in cases of hemorrhage from accidents.

The buffy coat of the blood so visible in most inflammations is referrible to the slower coagulation, by which greater time is given for a more complete separation of the red particles. This is accounted for by supposing that the blood has acquired a higher degree of vitality. The quantity of blood circulating in the body is estimated at from 25 to 30 lbs.; of this four fifths are supposed to be venous, the rest arterial.

RESPIRATION.

Respiration includes the acts of *inspiration*, and *expiration*, and is also divided into the *mechanical* and *chemical* process.

The *mechanical* act of respiration is performed by the mechanical agents which inhale or expel the air from the lungs; they are the parietes of the thorax, and the respiratory muscles.

The principal *muscles of inspiration*, are the diaphragm, intercostals, trapezius, and serratus magnus: in addition, we have the following muscles, which act during forced inspiration: pectorales major and minor, serratus superior posticus, levatores costarum, sterno-mastoid, and scaleni. The principal muscles of *expiration* are the abdominal muscles, quadratus lumborum, levator ani, triangularis sterni, serratus inferior posticus, longissimus, and latissimus dorsi.

During inspiration, the thoracic parietes are separated to a further extent than in the quiescent state, by which a vaccuum would be formed between them and the outer surface of the lungs, were it not that the atmospheric air rushes in to fill these organs; thus constituting the act of inspiration. In this action the ribs are raised and thrown outwards, the intercostal spaces widened, the sternum projected forwards, and the costal cartilages twisted; expiration succeeding, the air is again expelled. By this alternate dilatation and contraction of the thorax, the atmospheric air is brought in contact with the venous blood contained in the branches of the pulmonary artery; and thus those chemical changes are effected which constitute the *chemical* act of respiration. The atmospheric air is composed of oxygen 21, with a small quantity of carbonic acid, not much more than one part in a thousand, nitrogen 79, and a little watery vapour. Of these, the oxygen is the most essential, as it unites with the carbon in the venous blood, forming carbonic acid, which is expelled during expiration, and by the separation of which gas, the venous is converted into arterial blood. The nitrogen is of use in diluting the oxygen, which in its pure state is too powerful a stimulant to the system. The carbonic acid exists in the air only as an adventitious ingredient. During respiration, a part of the oxygen disappears and is replaced by carbonic acid; about a fourth of the oxygen inhaled appears to pass into the blood, and its volume to be supplied by carbonic acid in the air which is exhaled; with this also, a portion of watery vapour is given off from the lungs, and is supposed to be derived from the venous blood. The quantity of carbonic acid evolved from the lungs is estimated at about 24,000 cubic inches in twenty-four hours, sufficient to afford 11 ounces of solid carbon. Nitrogen passes from the lungs in about the same proportion as it enters; hence most conclude that it does not enter into the blood; but from experiments recently performed, it would appear that nitrogen is absorbed together with oxygen. The mode by which the atmosphere acts upon the blood is not quite agreed upon. The opinion supported upon the best evidence is that oxygen enters the blood in the air-cells, and that carbonic acid passes out by a species of vital transmission, named endosmose and exosmose; that the oxygen of the arterial blood in the capillary vessels, meeting with carbon, unites with it, and thus forms carbonic acid, which passes along with the venous blood to escape from the lungs. Others conceive, that the union of carbon with oxygen, takes place in the air-cells, and not in the capillaries of the system at large; whatever be the process, by means of respiration, the dark venous blood in loosing carbon is converted into bright-red arterial. The latter, besides its difference in colour contains less serum, is of a higher temperature, by about one degree, and coagulates more slowly when taken from the body.

Animal heat. All animals possess the power of generating heat, and of preserving their temperature for a greater or less period of time. This property appears to depend mainly upon the changes which the blood undergoes during its circulation. Crawford considered that, by the formation of carbonic acid in the lungs, heat was evolved and was absorbed by the arterial blood in consequence of its having acquired an increased capacity for caloric, by means of parting with carbon; that the arterial blood, by conversion into venous in the capillaries, had its capacity for caloric diminished, and consequently that latent heat was set free in the various parts of the body. A theory of this kind is the prevailing one at present. The source of heat then appears to be the oxygen, which like all gases contains latent heat. This gas entering the blood is conveyed by the arteries to the capillaries, where it meets with carbon; by their union, condensation ensues, (for the oxygen, by combining with carbon, acquires no addition to its volume, and increased specific gravity results,) and some latent heat of the oxygen is set free. The dense carbonic acid passing off, is replaced by the more rarefied oxygen, and thus a perpetual supply of heat is obtained. This theory is supported by numerous facts which are recorded in larger works on physiology. Some ascribe the production of animal heat to the agency of the nerves; and, from experiments performed, it would appear that these nerves contribute in some degree to the production of heat. In confirmation of this, Sir B. Brodie details the following experiments: Two rabbits were killed, one only by division of the spinal marrow in the upper part of the neck; in the latter, artificial respiration was kept up, and notwithstanding that the usual changes took place in the blood, this animal cooled more rapidly than the rabbit in which the artificial respiration was not resorted to. This experiment has been since repeated with somewhat different results. If we reflect on the lower temperature of a paralysed limb, and of animals in which the nervous system is less developed, we cannot hesitate to concede to the influence of the nerves some effect in maintaining the temperature of the body. It is most probable that the phenomena of animal heat, as is the case with most other functions of the human body, are to be referred not to one agent alone, but to the combined influence of that general organization, which exists in all perfect animals.

Use of the spleen. The physiology of the spleen is not understood. By some it has been thought subservient to the function of the liver, by preparing a fluid for the vena portæ. Others consider it subservient to the stomach, and that it receives the surcharge of blood when the stomach is empty. The most rational theory is that of Mr. Dobson; he found that the spleen receives most blood during digestion, and that, when digestion is completed, it recovers its normal condition. Hence he imagined that the spleen becomes a reservoir or diverticulum for a part of the blood, until the system can accommodate itself to the additional fluid which has been thrown into the circulating mass of fluids. Some modern physiologists (Tiedemann and Gmelin) imagine that the spleen is subservient to producing the colouring matter of the blood, and that it indeed may be said to form the red globules.

On membranes. Cellular tissue, substance, or membrane, is found in most, if not all, the structures of the body; in the more solid organs, it forms the basis in which their proper tissue is deposited, as the ossific matter in bone, fibrine in muscle, &c. In the simply condensed state, with the addition of a greater supply of vessels and nerves, it forms the membranes. Cellular membrane also fills up the interstices between the different structures of the body, thus giving to it, in great part, its rounded form; this substance consists of numerous cells containing generally a thin serous fluid, and has been divided into *reticular* and *adipose;* the cells of the former communicate freely, those of the latter are not connected, and are filled with adipose matter. Cellular membrane is not highly organized, and few vessels and nerves are distributed to it.

The membranes of the body are divided into the *simple* and *compound;* the *simple* are the *serous*, *fibrous*, and *mucous;* the *compound* are the *fibro-serous* and *fibro-mucous.*

Serous membranes present the following characters: they line cavities, and form shut sacs, the only exception being the peritoneum in the female, in which, the mucous lining of the fallopian tubes is continuous with the peritoneum; they present a free secreting surface, which is smooth and polished, and an outer cellular or attached surface; they secrete a serous halitus, are destitute of red vessels in the healthy state, and are prone to the adhesive inflammation. The serous membranes are the *arachnoid*, *pleura*, serous layer of the *pericardium*, *peritoneum*, and, in the male subject, the *tunica vaginalis*. Synovial membranes and bursæ mucosæ belong to the class of serous membranes forming shut sacs, but they differ in their secretion, which is an albuminous glairy fluid.

Mucous membranes cover exposed surfaces, present a soft villous appearance, are highly organized, being possessed of numerous vessels and nerves, and are prone to the suppurative inflammation. Mucous membranes present two large surfaces, which are named the *gastro-pulmonary*, and the *gastro-urinary*. The gastro-pulmonary mucous membrane commences at the conjunctiva, whence it descends to line the pharynx, larynx, lungs, nose, mouth, and alimentary canal. The genito-urinary, lines the kidneys, ureters, bladder, urethra, &c. In the female, a distinct mucous membrane lines the lactiferous ducts: considerable analogy exists between the mucous membranes and skin.

Fibrous membranes are of greater extent than either the serous or mucous; they are composed of fibres variable as to direction; they are dense, strong, possessed of little elasticity or extensibility, are but imperfectly organized, with the exception of the periostea, and are liable to the sloughing process. The dura mater, periosteum, ligaments, &c. are examples of fibrous structures.

Fibro-serous membranes are fibrous lined by serous membrane; the dura mater and pericardium are examples of them. The lining membrane of the nose, palate, &c., are instances of fibro-mucous membranes.

Secretions. The term secretion is applied to that process by which the elements of the blood are separated in a peculiar manner, so as to form new proximate principles and compounds in the various organs. The structure of the parts in which secretion is performed is known by dissection; but the cause of the difference in the products is still a mystery.

Secretions are all formed from membranes variously modified and arranged. The requisites for a secreting surface are ramifications of an artery, vein, nerve, and absorbent. The serous, synovial, and mucous membranes present the most simple forms of secreting surfaces. In the more complex organs, secretions are poured out from the walls into reservoirs, which are named according to their shape: 1st, there may be a small pit or depression, named a *crypt;* 2d, this may be surrounded on all sides and constitute a *vesicle* or *cell;* 3d, this cell may be contracted at one end like the neck of a bottle, and is named a *follicle*; 4th, the follicle may be elongated uniformly without presenting the neck and broader portion, and is named a *cæcum* or *pouch;* 5th, the pouch may be still more elongated, and constitute a *tube* (tubulum).

In all these forms, the fluid is considered to be elaborated in the capillary arteries on the walls of the secreting organ; not to be poured out by vessels terminating in open mouths, but to pass from the arteries through the membrane by a power of transudation, named *exosmose.*

Secretion of *tears.* The tears are secreted by the lacrymal gland, from whence they are conveyed by six or seven excretory canals to the upper and outer part of the eye, where they pass through the conjunctiva, and are carried by a triangular canal, formed by a meeting of the eyelids, to the inner canthus of the eye; here they are absorbed by the puncta lacrymalia, and conveyed by two tubes to the lacrymal sac. From the lacrymal sac the tears pass by the nasal duct into the inferior meatus of the nose.

The tears keep the cornea moist, moderate the friction of the eyelids on the eyes, and wash away any extraneous bodies which may have fallen into the eye.

Secretion of *milk.* The milk is secreted in the glandular substance of the mammæ. The tubuli lactiferi commence in numerous small portions, called lobules. As they approach the nipple, the ducts unite into twelve or fifteen of considerable size, which terminate on the surface of the nipple by open mouths.

Secretion of *bile.* The bile is secreted in the liver by the minute branches of the vena portæ into the lobules, from which it passes along the excretory ducts, called the pori biliarii, into the hepatic duct; this, with the cystic duct, forms the ductus communis choledochus, which terminates in the duodenum. It is considered by most authors, that the blood of the vena portæ, having more carbon and hydrogen than that of the hepatic artery, is more proper for furnishing the elements of the bile. When digestion is not going on, the opening of the ductus choledochus is closed by the contraction of the duodenum, and the bile therefore, not finding access into it, regurgitates into the gall-bladder, where it acquires greater consistence. When the duodenum is distended with chyme, the irritation it produces is propagated to the gall-bladder, the parietes of which contract, and force the bile along the cystic duct into the ductus communis choledochus, and from thence into the duodenum. The use of the bile is to separate the nutritious from the excrementitious portion of the chyle; to precipitate the feculent principles, of which it forms indeed a large portion: it also may be considered a respiratory function, as far as removal of carbon from the blood is concerned, and is the chief cause of the peristaltic action of the fecal matter. If the ductus choledochus be tied, the bowels are found to be constipated to a most obstinate degree.

The *urine* is secreted by the capillary branches of the renal artery, and is first poured into the tubuli uriniferi; these partially communicate together, and open on the papilla or mamilla by 10 to 15 orifices; the urine is then received by the calices from which it passes into the infundibula; from these into the pelvis of the kidney, and next down the ureter into the bladder. The oblique manner in which the ureter perforates the bladder prevents the urine returning; for when the bladder is distended, the pressure of the urine against the walls of this tube produces a valvular effect. When the urine has collected in the bladder, and a desire is felt to void it, the muscular coat of the bladder is called into action, and is aided in its contraction by the pressure of the abdominal muscles and viscera, and the diaphragm, the sphincter fibres of the neck of the bladder being relaxed and overpowered. The urine is an outlet for nitrogen which escapes in the form of urea and uric acid; likewise for numerous superabundant salts. Its suppression is usually attended with alarming and more frequently fatal symptoms.

Secretion of *semen.* The semen is secreted by the minute branches of the spermatic artery, and poured into the tubuli seminiferi, from which it passes successively along the vasa recta, vasa afferentia, into the vasa deferens; it proceeds along this, towards the vesicula seminalis of the same side, which it enters, according to some, to be mixed with the proper fluids of the vesicula, or is collected in its own distended duct; from this point it passes along the ductus ejaculatorius communis into the urethra, on the side of the verumontanum; here, in its passage along the urethra during emission, it is mixed with the fluid from the prostate and Cowper's glands, and mucous membrane of the urethra.

Of the brain and organs of sense. The uses of the brain in the animal economy, are very numerous and important. It is the material organ of the intellect or mind; gives, through the medium of the nerves, the power of voluntary motion; is the seat of sensation and of sympathies, and exerts more or less influence upon all the vital phenomena.

The *sensations* are those functions destined to receive the impression of external objects, and to transmit them to the intellect. They are five in number, viz., vision, hearing, smell, taste, and touch.

Vision. The rays of light, emanating from surrounding objects, and falling on the cornea, are in part reflected, and thus contribute to form the brilliancy of the eye. The transparent cornea refracts the remaining rays, and thus increases the intensity of light; the rays then pass through the anterior chamber, pupil, and posterior chamber to the lens. The number of rays which fall on the lens is regulated by the iris, which contracts or dilates, to allow more or less light to pass through the pupil, according as an object may be more or less lighted. Those rays that fall on the iris are reflected, and returning through the cornea, exhibit the colours of the iris. The crystalline lens, both from its structure and form, very powerfully refracts the rays, and collects them into a focus in the vitreous humour, from which point they diverge, and are spread out upon the retina in the bottom of the eye, where the impression is received and conveyed along the optic nerve to the brain, and produces vision. The object is depicted upon the retina in an inverted manner.

The *conjunctiva* protects the anterior surface of the eye; it secretes a fluid which mixes with the tears, and seems to have the same use; it supports the pressure, when the eye is moved, and being always polished and humid, it gives much facility to motion.

The *sclerotic* coat is evidently a powerful protection to the more delicate parts of the eye; and serves, besides, as a point of insertion for the muscles that move the eye.

The *choroid* membrane is the most vascular coat of the eye, allowing the ramifications of the vessels, and, from its most internal layer, secreting the pigmentum nigrum. The secreting membrane is now called membrana pigmenti.

The *pigmentum nigrum* absorbs the light after it has traversed the retina, and thus prevents dazzling.

The dark matter called *uvea*, on the posterior surface of the iris, appears to absorb those rays that may be reflected by the polished surface of the crystalline lens.

The use of the *ciliary processes* is not perfectly understood. By some they are considered to secrete the aqueous humour. Haller thinks that they maintain the lens in the most advantageous position. Some physiologists believe that they are muscular, and are able to produce changes in the convexity of the lens.

The *eyebrows* guard the eyes from external violence by the projection which they form; they protect the eyes from too much light, particularly when it comes from above; and they prevent perspiration flowing towards or irritating the surface of the eye.

The *eyelids*, during sleep, cover the eyes, and thus protect them from the contact of any foreign bodies floating in the air; they moderate the force of a too brilliant light, and by their regular and habitual motion preserve the eyes from the effects of the continued contact with the air, and by their sudden closure guard them from any shock. They also assist materially in causing the passage of the tears from the surface of the eye into the lacrymal sac.

The secretion from the *meibomian* glands facilitates the motion of the eyelids, and prevents (by greasing, as it were, the edges of the lids,) the tears from running down upon the cheeks.

Hearing. The external ear, or pinna, collects the sonorous undulations, and directs them towards the meatus auditorius externus. This trumpet-like tube concentrates and conveys them to the membrana tympani: the sonorous waves striking against this membrane cause it to vibrate; this vibratory motion will also be given to the malleus, which is in contact with this membrane: the malleus moves the incus; the incus, the os orbiculare, and the latter moves the stapes. Now the base of the stapes being attached to the membrane closing the fenestra ovalis, it is evident that the stapes must act the part of a piston, that is, compressing or agitating the fluid in the vestibule, semicircular canals, and cochlea. The motion of this fluid produces an impression upon the auditory nerve, which almost fills the labyrinth; and this nerve, receiving the impression, conveys it to the brain.

The *Eustachian tube* admits the free passage of air into and from the cavity of the tympanum, thus preserving a due balance with the external air, and enabling the membrana tympani to move in obedience with the slightest impression.

The *mastoid cells* are supposed to augment the intensity of sound.

Of *taste.* To produce the sensation of taste, the food must be moistened and applied to the tongue. The minute branches of the lingual nerve of the third division of the fifth pair receive the impression and convey it to the brain.

Of *smell.* The air, filled with odorous effluvia, which are exhaled from most bodies, being received into the nostrils by inspiration, carries these particles to the olfactory nerve, which is expanded upon the surface of the pituitary membrane. By these means a kind of sensation is produced which we call smell. Mucus is secreted to preserve the extremities of the nerves, and to lessen the too strong impression that would arise from the immediate contact of the odoriferous particles.

Of the functions of the *skin*. The cutis vera, or true skin, forms the organ of touch; besides which, it is a medium for absorption, and has a function analogous to that of the lungs, namely, the discharge of useless carbon from the system. The carbonic acid produced in the process is formed in the capillary vessels by the union of the carbon of the body with the oxygen of the atmosphere received by inspiration. The skin is also a very important moderator of the animal heat. If the body be exposed to a high temperature, perspiration is increased, and passes off in a state of vapour, which by its increased capacity for heat, absorbs and abstracts the free heat of the body. By this, men are enabled to enter and remain in ovens heated to 250 degrees without injury. The absorption has been proved by putting persons into baths, and weighing them both before and afterwards. A sensible increase in weight has been noticed after the immersion. The cuticle, or epidermis, seems to blunt the otherwise too acute sensibility of the cutis vera, and to protect it from the impression of external bodies.

Of the *voice*. The air expelled from the lungs passes through the trachea and larynx. In the latter, the passage for it is much smaller than in the trachea, and the air is forced through a narrow slit, the two sides of which are vibrating planes, and which thus produce sonorous undulations in the transmitted current of air. The intensity of the sound depends on the length of the chordæ vocales, the distance between them, and the force with which the air is expelled. The depth and shrillness of the voice depend upon the changes produced on the size of the opening of the glottis by its muscles and ligaments, and articulation upon the movement of the muscles of the mouth and palate.

ANIMAL CHEMISTRY.

Animal matter consists of several proximate principles, all of which, with the exception of fat and cholesterine, contain oxygen, hydrogen, nitrogen, and carbon. The nitrogen is absent in the fat and cholesterine.

Fibrine, which exists in muscle and blood, has been previously described, (p. 304.)

Albumen exists in the serum of the blood, in the fluid of serous cavities, and in cellular membrane, skin, and vessels. It is soluble in water, and in the liquids of the body is generally combined with some free soda. It is best known by coagulating by heat, at 160° if undiluted, and in any quantity even diluted, at 212°. It forms a precipitate with bichloride of mercury, tannin, and many metallic salts; is coagulated by galvanism and dilute acids. Its elements exist in nearly the same proportions as those of fibrine and gelatine.

Gelatine is found in the skin, tendons, cartilages, membranes, and bones, and in its purest state in isinglass. It does not exist in the healthy fluids of the body.

Properties. Very soluble in warm water, becoming somewhat solid on cooling; forms a brittle mass, when its water is expelled, as in glue; insoluble in alcohol; miscible with or soluble in weak acids and alkalies; has a feeble affinity for metallic oxides, does not precipitate bichloride of mercury; it forms a dense precipitate with tannin, called tanno-gelatine, which is the basis of leather. It is considered to be almost isomeric with albumen: it appears, however, to contain a little more oxygen.

Urea is contained in urine, from which it is procured by the following process: Evaporate urine to the thickness of syrup, then add nitric acid, which will form a nitrate of urea, insoluble in iced cold water; to this, after washing it repeatedly, add carbonate of potash, which forms a nitrate of potash, carbonic acid flies off, and the urea is set free; it is then to be taken up by water, and treated with charcoal to decolorize it: the solution being evaporated, urea is left. To obtain it in pure crystals, it may be repeatedly dissolved in alcohol.

Properties. Colourless, transparent; has a faint, but not urinous smell; is cool to the taste, very soluble in water, less so in alcohol; does not change litmus or turmeric paper; by heat is decomposed, forming carbonate of ammonia. It is composed of oxygen, hydrogen, nitrogen, and carbon, in the proportions for forming cyanate of ammonia.

Uric acid is found in the urine and gouty concretions, also in the solid excrement of the boa-constrictor, from which it is obtained most easily.

Properties. It is white, tasteless, and inodorous, requiring 10,000 times its volume of water at sixty degrees for solution; mixed with nitric acid and heated, a purple colour is produced, owing to the formation of purpurate of ammonia. This acid unites with alkalies and earths, and in a combined state is always found in the urine: when free, it is deposited, and forms a reddish sediment.

Salivary concretions are chiefly composed of carbonate and phosphate of lime.

Gall-stones consist of adipocire, with a quantity of colouring matter; or, according to Chevreul, of yellow colouring matter, and a peculiar principle which he named cholesterine.

Milk is composed of water, caseous matter, sugar of milk, hydrochlorate, phosphate, and lactate of potash, lactate of iron, and earthy phosphates.

The chief constituents of *bone* are animal matter, phosphate and carbonate of lime, phosphate of magnesia, fluate of lime and water. The following is from the analysis of Berzelius:

Gelatine soluble in water	32.17
Vessels	1.13
Subphosphate of lime, with a little fluoride of calcium	53.04
Carbonate of lime	11.30
Phosphate of magnesia	1.16
Soda, with a trace of chloride of sodium	1.20
	100.0

The *brain* is composed of water, white fatty matter, red fatty matter, albumen, ozmazome, phosphorus, salts, acids, and sulphur.

Chalk-stones, or gouty concretions, are composed principally of uric acid and soda.

The *humours* of the eye consist of water, albumen, animal matter resembling gelatine, and several neutral salts.

Ligaments are composed chiefly of coagulated albumen and some gelatine.

Mucus of the nose contains water, mucous matter, salts of potash and soda, albumen, and animal matter.

The *nails* are composed of coagulated albumen, gelatine, and a little earthy matter.

Muscle contains about seventy-five per cent. of water, the rest consisting of fibrine, with gelatine, ozmazome, albumen, neutral salts of soda, lime, and ammonia.

Synovia is a compound of water, fibrinous matter, albumen, salts of soda, and lime.

Tears contain water, albumen, mucus, and several neutral salts.

The *teeth* are formed of phosphate of lime, carbonate of lime, and cartilage. The enamel is devoid of cartilage.

Tendons are composed principally of gelatine.

Pus is ordinarily a viscid liquid, of a yellow colour, slightly inclined to green, opaque and homogeneous; inodorous, possessing a feeble taste, neither acid nor alkaline, although it soon becomes acid on exposure to the air, with disengagement of ammonia; examined by a microscope, it exhibits an appearance of globules. It is not soluble in water, and after agitation it falls to the bottom; is coagulated by boiling heat and diluted acids; is soluble in strong sulphuric and nitric acids; also in caustic potash, but is precipitated from them when water is added.

Urine is a limpid yellowish fluid, with an acid reaction averaging in specific gravity 1.030. It is speedily decomposed when exposed to heat, and ammonia is generated in considerable quantity. The urine contains, according to the analysis of Berzelius, in 1000 parts:

Water	933.00
Urea	30.10
Free lactic acid, lactate of ammonia, ozmazome soluble in alcohol, and extractive soluble in water	17.14
Uric acid	1.00
Mucus of the bladder	0.32
Sulphate of potash	3.71
Sulphate of soda	3.16
Phosphate of soda	2.94
Biphosphate of ammonia	1.65
Chloride of sodium	4.45
Muriate of ammonia	1.50
Phosphate of lime and magnesia	1.00
Silica	0.03

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Page 38,	*line* 13,	*for* backwards,	*read* forwards.
54,	39,	tertius,	longus.
104,	2,	closed,	classed.
184,	5,	midalia,	pyramidalia.
197,	20,	inferior thyroid,	inferior laryngeal.
250,	18,	30 to 40	20 to 30.
—	22,	inches,	ounces.
265,	8,	appendices,	appendix.
345,	11,	anterior,	an.
356,	29,	restoring,	restraining.
369,	38,	external,	internal.

PART II.

Page 10,	*line* 20,	*for* found,	*read* formed.
22,	31,	ruptured,	not ruptured.
126,	25,	belt,	bath.
131,	11,	a pus,	a slough.
142,	37,	chord,	canal.
160,	2,	and,	or.
—	10,	chiefly,	already.

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